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STATE OF IDAHO
DEPARTMENT OF HIGHWAYS
Materials Laboratory
Boise, Idaho

FIELD CONTROL

OF

ASPHALT PAVEMENT CONSTRUCTION

By

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ABSTRACT

This research project was initiated to determine a test method which could be used for the compaction control of asphalt pavement construction.

Test procedures and results are described for two nuclear density gages and an asphalt paving meter. The results indicate that both nuclear gages could be used for plant mix compaction control. The asphalt paving meter is not accurate enough for compaction control.

INTRODUCTION

Since plant mix has become one of the major materials for pavements in Idaho, a need has developed for a method of compaction control during the construction of the pavement. In 1967 the Idaho Department of Highways initiated a research project to determine the feasibility of using nuclear density gages and an Asphalt Paving Meter to control the compaction of the plant mix during pavement construction. The equipment used during the project was a Model A-230F Troxler Nuclear Density Gage with a Model 200B Scaler, a Model 75 Seaman Nuclear Gage, and a Soiltest Asphalt Paving Meter. The Asphalt Paving Meter is referred to as the air permeameter throughout the remainder of this report.

The general objectives of the research project were as follows:

1. Determine the reliability of the nuclear density gages and air permeameter by a comparison of their results to corresponding core densities and air voids.

2. Investigate the density relation at various stages of the rolling sequences.

3. Examine the effect of rolling temperatures on final asphalt core densities.

4. Determine the transverse variation in the pavement characteristics caused by normal construction procedures.

TESTING PROCEDURES

The research work was initiated on the S-3804(3) project, Mountain Home-SH 51. Nuclear density and permeability tests were performed on selected sites during the various stages of the rolling sequence, and these sites, with 12 random sites were core-drilled for a comparison.

The ~~test~~ results of these tests are listed in Appendix A, Table 1. The density correlations with both gages against the core densities were erratic and no analysis was made on the data. The correlation between the core air voids and permeability readings were also quite erratic. ~~This poor correlation was due to the inexperience of the operator using the nuclear gages and the air permeameter.~~

Nuclear density and air permeameter readings were taken on the I-80N-4(1)220 project between Cotterell and the Salt Lake Interchange. Seven sites were core drilled for density comparisons. Because of the traffic seal on the pavement surface of this section the air permeameter registered such low readings that they were not used in any analyses.

The core data and nuclear readings for this project are listed in Appendix A, Table 2. There were not enough cores taken to establish a correlation with either nuclear gage. ~~Core No. 7 is an indication of the "chemical effect" of a particular site.~~ Core No. 6 was taken approximately eight feet from Core No. 7 but the differences in the nuclear readings

No

I'd omit this

were considerably higher than the corresponding core density differences. The surfaces of the test sites were basically the same.

On the I-80N-3(34)196 project, 24 random sites were tested with the Troxler equipment on the 0.2 ft. layer of Class B Plant Mix. Twelve of the Class B Plant Mix sites were also tested with the Seaman gage. All sites were referenced. After the 0.2 ft. layer of Class D Plant Mix was constructed over the entire project, the sites were tested using both nuclear gages. This procedure allowed for two density correlations per test site. Air permeameter readings were taken on the Class D Plant Mix surface at each site.

During construction of the Class D Plant Mix 24 rolling tests were performed to determine a density relationship at various stages of the rolling procedures. Nuclear density and air permeameter readings were taken after certain roller passes in the rolling sequence. All these nuclear density readings for a given test were taken at the same test site to eliminate any variations in the readings caused by corresponding variations in the material. A fine sand was used to reduce the air gap beneath the nuclear gage. The Troxler equipment was used exclusively during the rolling tests. However, density readings were taken at the test sites with the Seaman gage before the sites were core-drilled.

The rollers used during this study were as follows: breakdown roller, 2-axle, 17800 lb.; pneumatic roller, size 13:00 x 24 tires, at 70 psi pressure in the tires, weighing 4790 lb. per wheel; finish roller, 3-axle tandem weighing 27,000 lb.

Air permeameter tests were performed in conjunction with the Troxler density readings for the last 17 rolling tests. These tests could not be taken on the density test sites because of the grease residue left on the pavement by the tests. An average of four air permeameter tests were taken during the rolling sequence at different locations as close as possible to the nuclear test sites. If the pavement temperature was above 210° F. the test was omitted because the grease was damaging the asphalt mat, ~~when the apparatus was removed from the pavement~~.

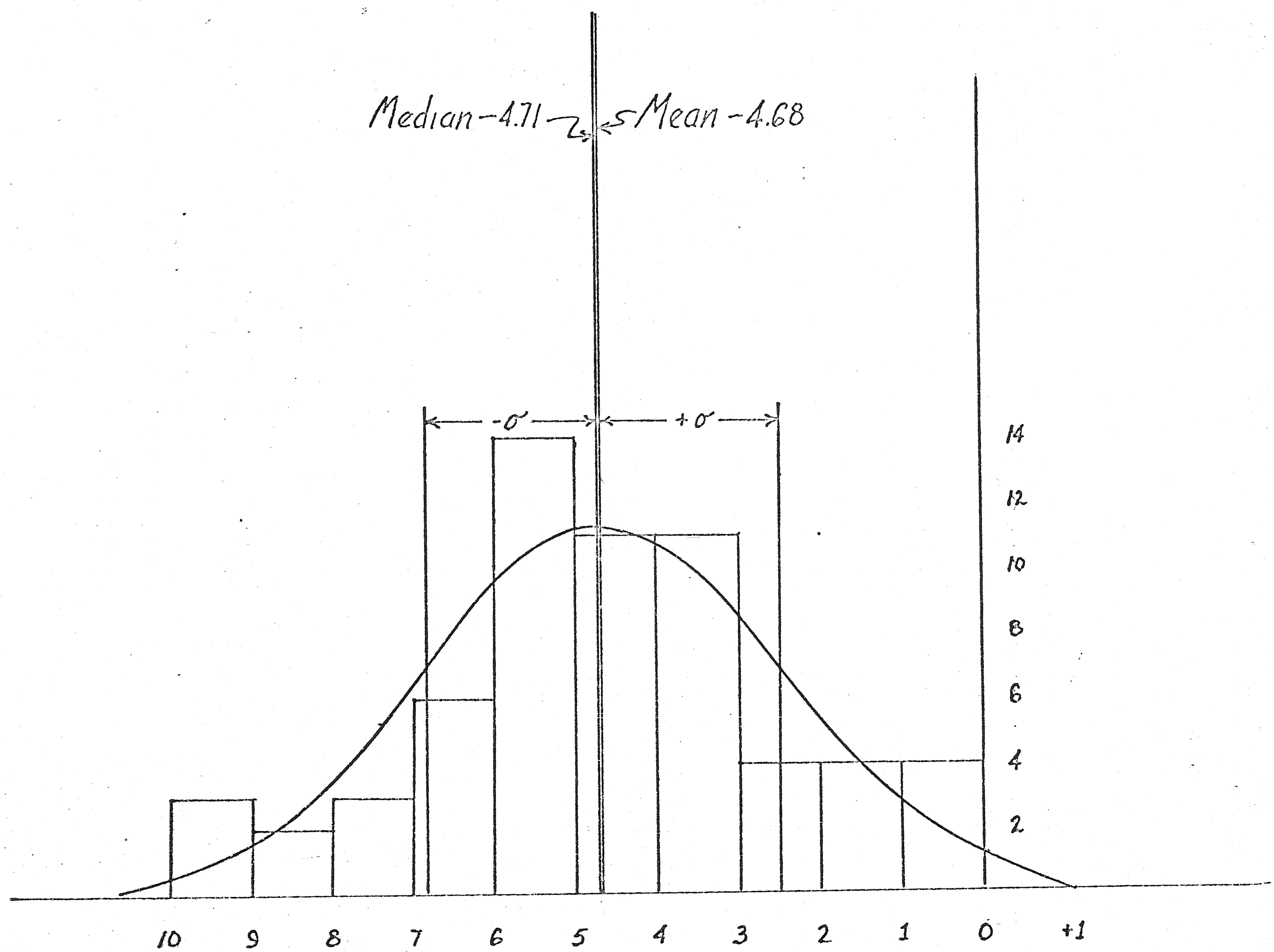
To determine the reliability of the nuclear density gages and the air permeameter the data listed in Tables 3, 4 and 5 of Appendix A were compared with core data. The results of the Troxler gage data analysis are shown in Figure 1. The standard deviation of the nuclear density when compared to the core density was ±2.19 pcf. There is no significant deviation between the distribution of the data and the normal distribution curve based on the P.05 level. The mean and median were located at an approximate value of -4.7 pcf which indicates the density line on the Troxler graph should be moved to the right as shown in Figure 2.

The results of the Seamans data analysis are shown in Figure 3. The standard deviation of the nuclear density readings was ±2.58 pcf. The mean value for the data was located at +1.0 pcf, while the median value was located at +0.3 pcf. There is a definite skewness to the positive side in the graph, which indicates a variance from the normal distribution curve at the P.05 level. In other words, the density gage has a tendency to record densities that are above the actual corresponding core densities. There was no adjustment made on the Seaman density graph as both the mean and the median were within one ~~pcf~~ pound per cubic foot of the core density.

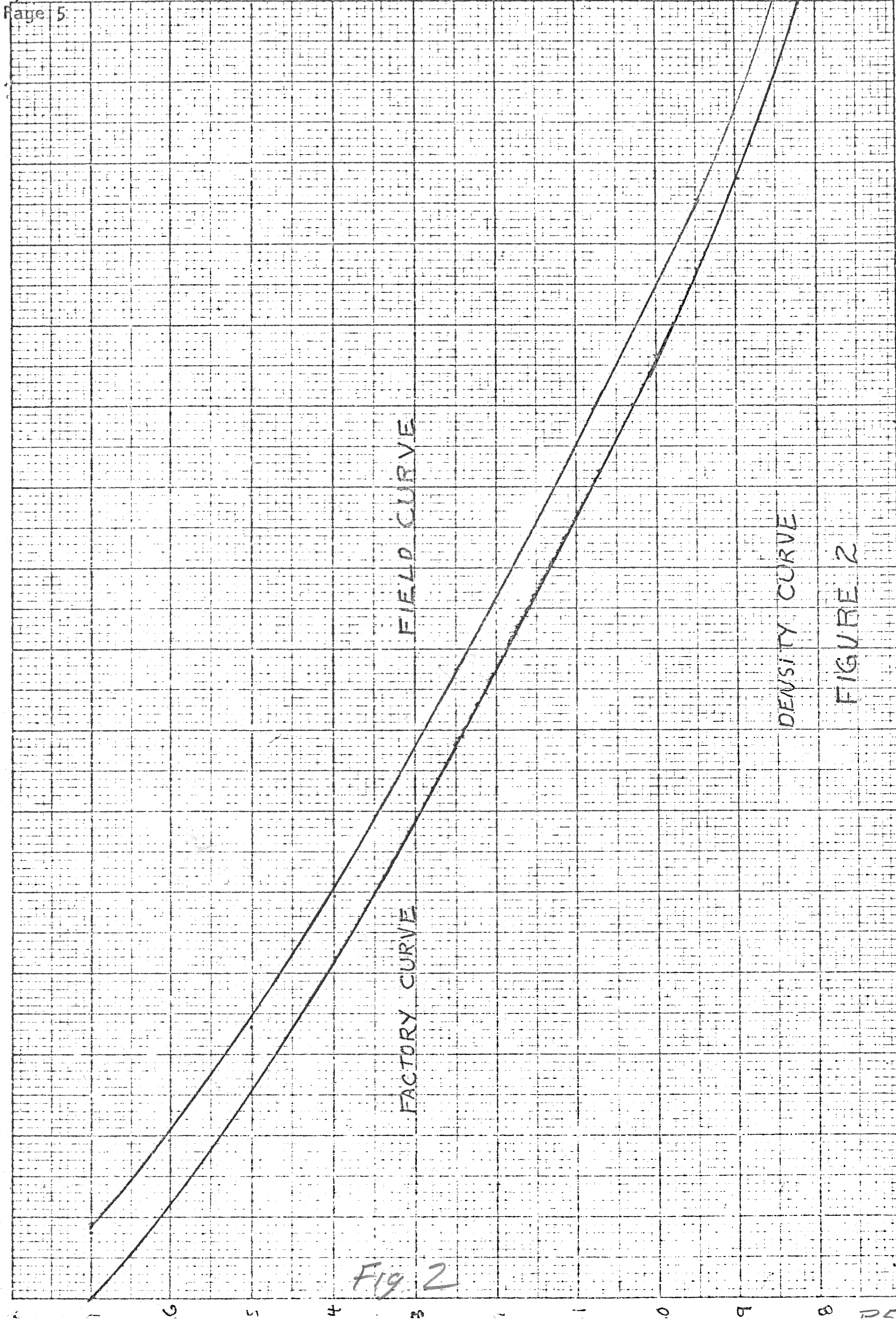
The test results pertaining to the effect of underlying material on the density gages were inconclusive. There were too many other variables (i.e., surface roughness and variations in the density gages) which more than offset any effects caused by the material beneath the test site.

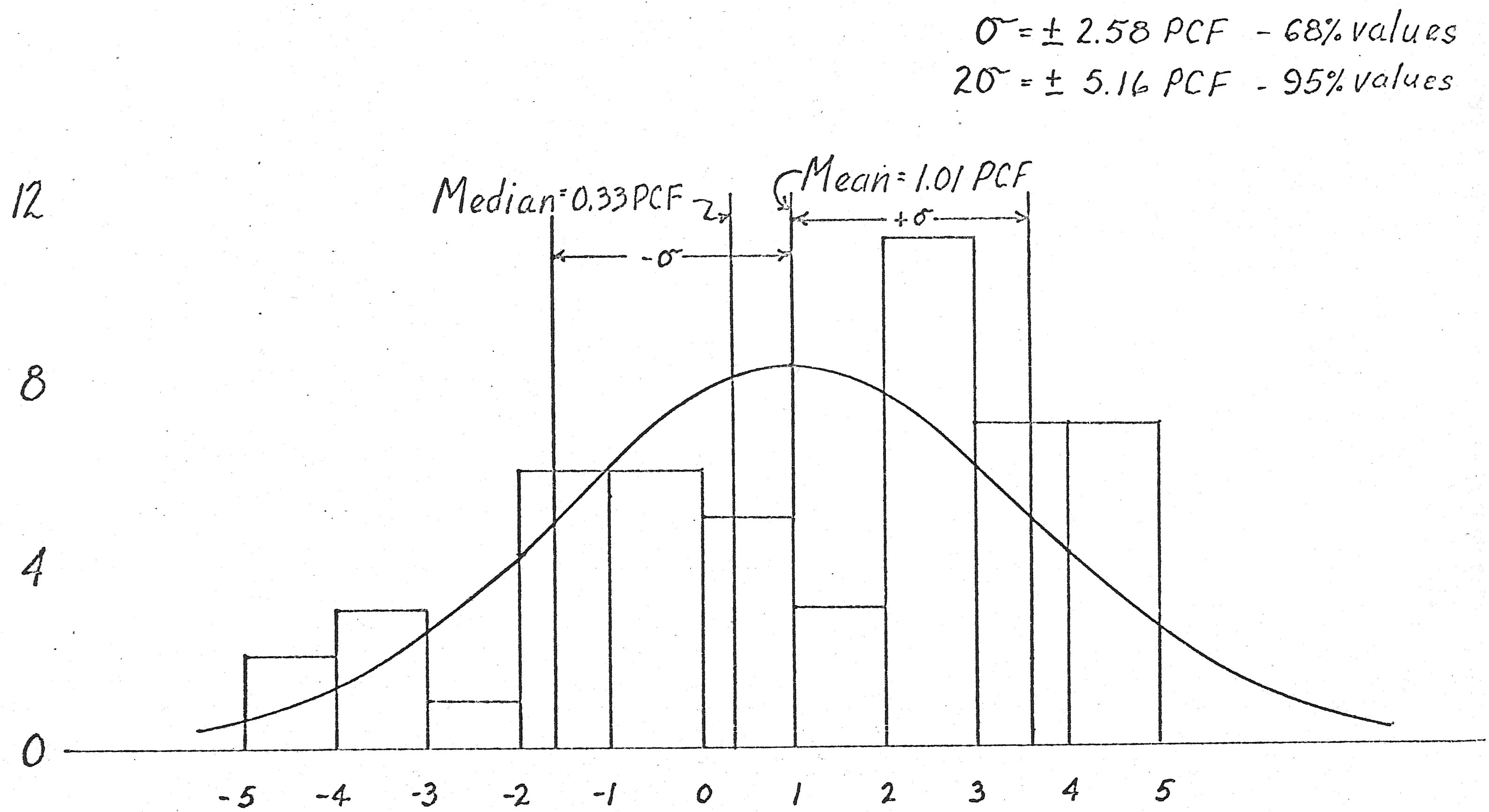
A comparison of both core density and air void values with air permeameter readings showed no apparent trend or correlation between either of

$\sigma = \pm 2.19$ - 67% of values
$2\sigma = \pm 4.38$ 95% of values



Probability Curve
Troxler Nuclear Gage
Fig 1


FIELD CURVE
FACTORY CURVE
DENSITY CURVE
FIGURE 2
Fig 2



Probability Curve
Seaman Nuclear Gage
Fig 3

the sets of values. The readings were influenced more by the surface texture at the test sites than by either the density or the air voids in the cores. A plot of permeameter readings vs. core density and air voids is shown in Figure 4.

The relationship of density to compactive effort, ~~on~~ or roller passes, is shown in Figures 5 and 6. In Figure 5 the average density growth curve is shown for a rolling sequence of two breakdown roller passes, five pneumatic roller passes, and one finish roller pass. The points on the graph are an average of five tests taken during this sequence of rolling.

Figure 6 shows an average density growth curve for a rolling sequence of ~~one~~ two breakdown, seven pneumatic and one finish roller passes. This is an average of 12 tests in this sequence. Both Figures show an apparent loss of density during certain stages of the pneumatic rolling sequence. It is believed that part of this apparent loss can be attributed to the effect on the gauge of ridges left in the pavement by the pneumatic roller in the early stages of the rolling sequence.

The average final density for both of these sequences was 128.4 pcf. This tends to indicate that the two additional passes with the pneumatic roller in the Figure 6 sequence were not necessary. Specific gravity variations at the test site and temperature variations during the rolling sequence would have affected the average density of the test sites. The rolling test results are listed in Appendix B, Tables 9-21.

Figures ~~I~~ 12, ~~II~~ 13, and ~~III~~ 14 in Appendix C show the temperature and nuclear density results of the 24 rolling tests at the conclusion of each roller phase. The final temperatures for each roller were plotted against the corresponding final core density to determine the effect of these temperatures. There were no definite patterns for the effect of the temperature

AIR PERMEAMETER READINGS
Vs.
CORE DATA

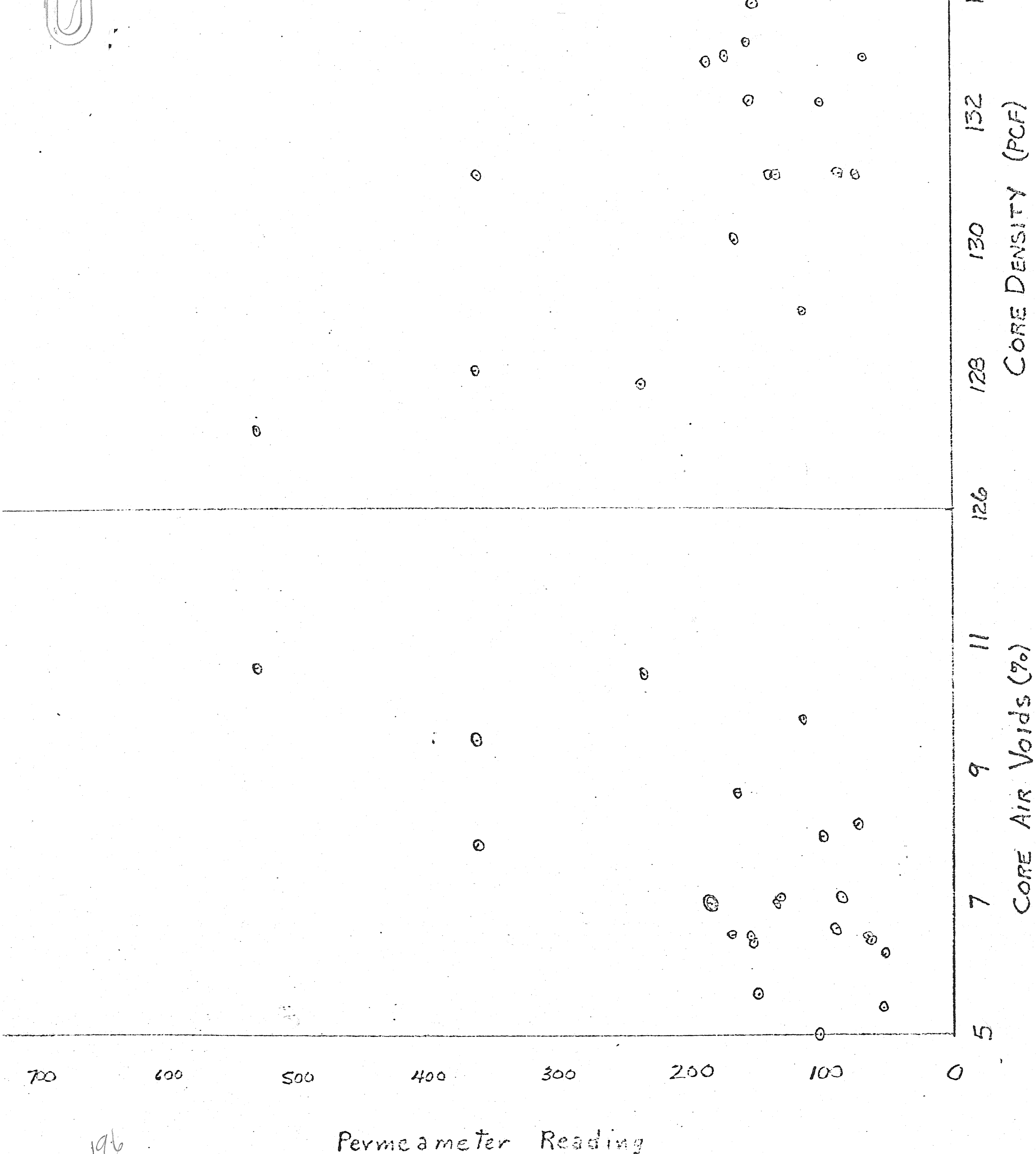


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FIGURE 4

I 80 N-3(34)196

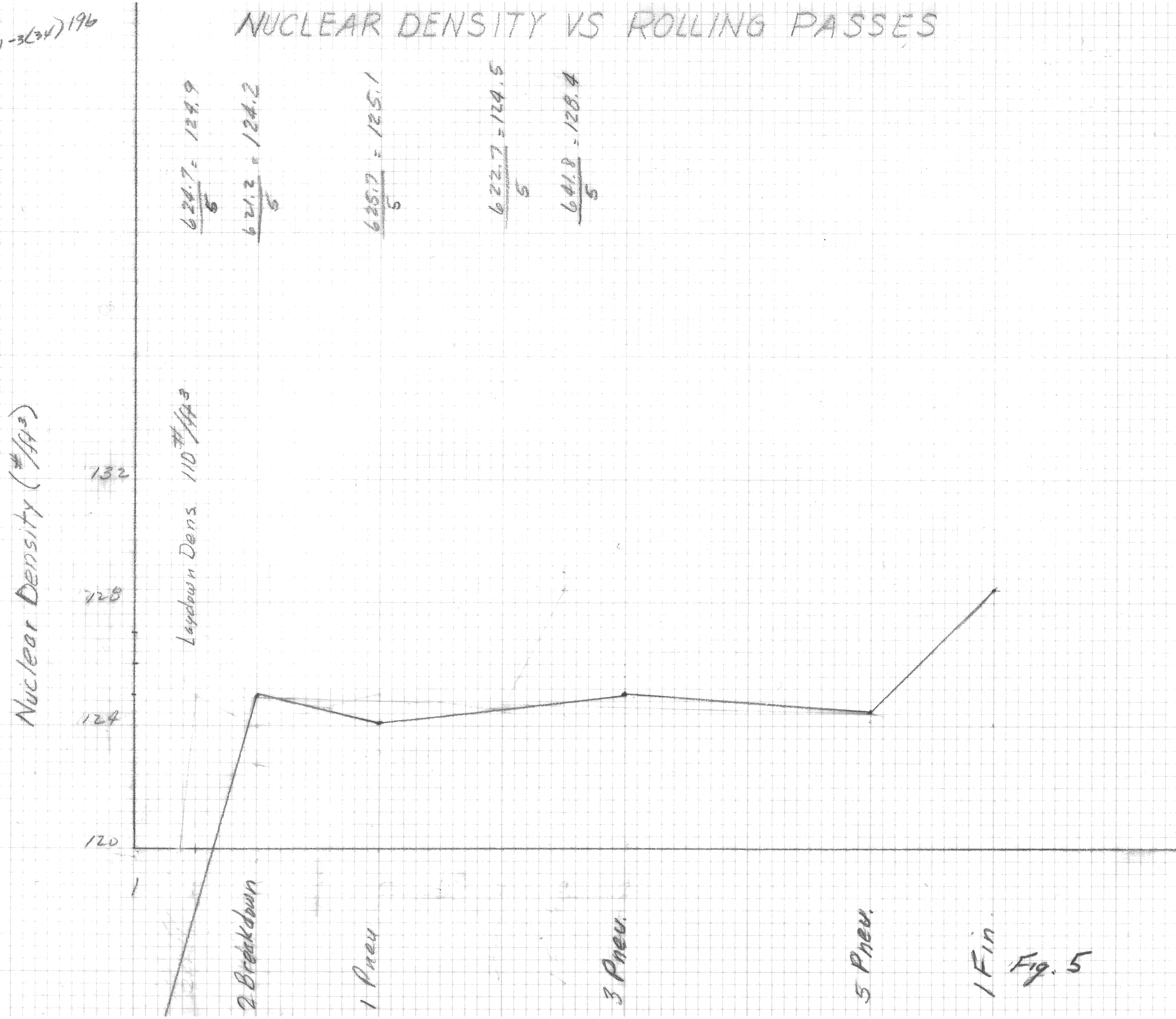
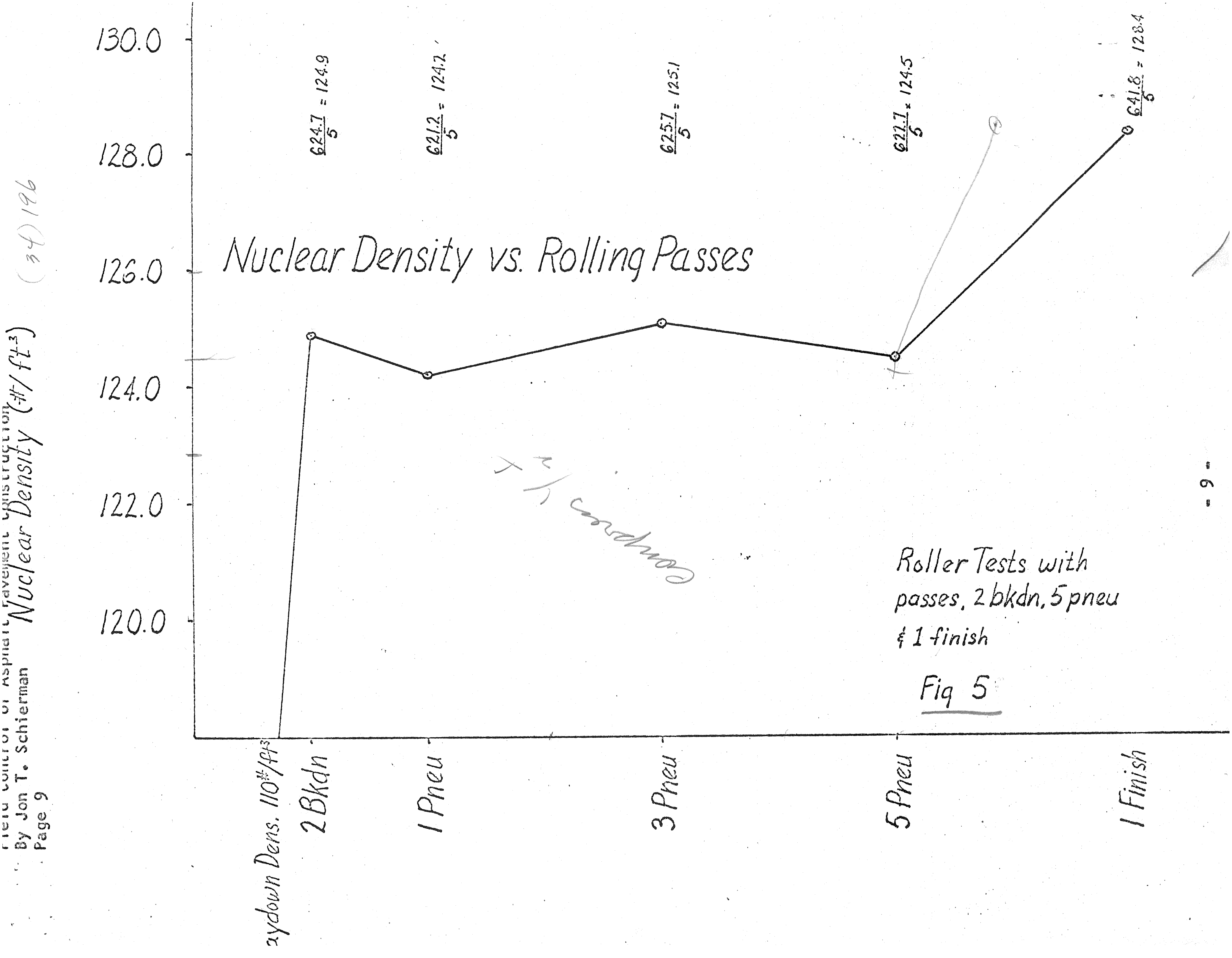


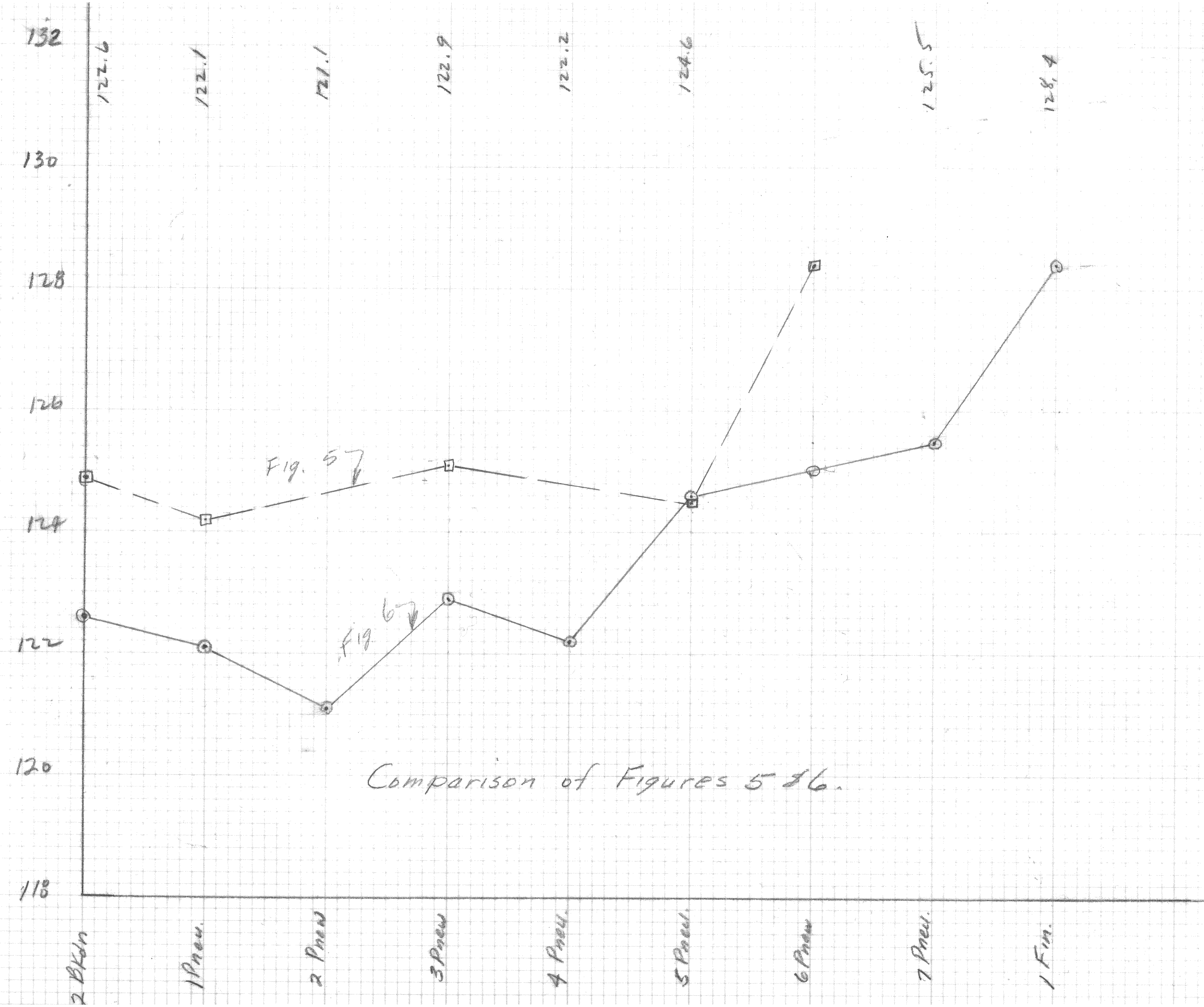
Fig. 5



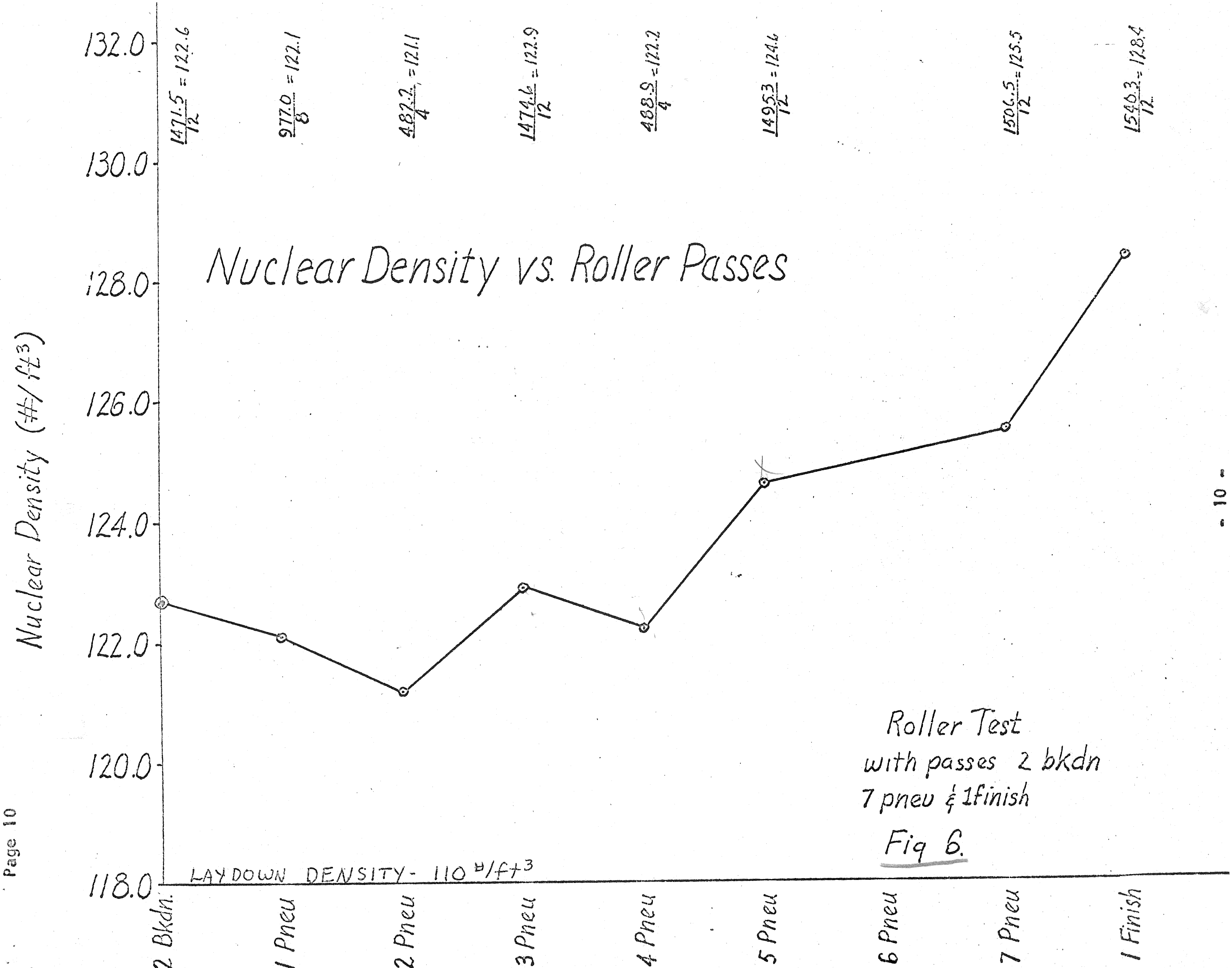
Roller Tests with passes, 2 bkdn, 5 pneu & 1 finish

Fig 5

(34) 196



Comparison of Figures 5 & 6.



Nuclear Density vs. Roller Passes
Nuclear Density (#/ft³)
132.0
130.0
128.0
126.0
124.0
122.0
120.0
118.0
1471.5/12 = 122.6
977.0/8 = 122.1
487.2/4 = 121.1
1474.6/12 = 122.9
488.9/4 = 122.2
1495.3/12 = 124.6
1506.5/12 = 125.5
1540.3/12 = 128.4
LAYDOWN DENSITY - 110 #/ft³
2 Bkdn.
1 Pneu
2 Pneu
3 Pneu
4 Pneu
5 Pneu
6 Pneu
7 Pneu
1 Finish
Roller Test
with passes 2 bkdn
7 pneu & 1finish

Fig 6.

on the final density on either the pneumatic or finish roller graphs. Figure 7 shows the results of a curvilinear regression analysis of the final core density in comparison to the breakdown rolling temperatures. Only 24 per cent of the core densities are within one standard deviation of this regression line. Specific gravity variations in the plant mix at the rolling test sites are the major reason for the low correlation. There is a general trend in the data, which indicates the final core densities were higher when rolling was completed at the higher temperatures.

Project I-15-2(17)72 Section "B" was a plant mix overlay with 0.1 ft. being laid in the travelway and 0.2 ft. being laid on the drop shoulders. Tests were taken on both. Nuclear density readings were first taken on the existing pavement to see what, if any, effect this density had on the rolling tests. This initial reading was not taken on the shoulder because the gages could not be seated properly on the 3/4-inch chip seal. Readings were taken at the initial site after the breakdown roller and the 3rd pass with the pneumatic tired roller. The fifth and seventh passes with the pneumatic tired roller were tested at sites approximately 25 and 50 feet ahead, respectively. All six sites were tested with both nuclear density gauges after the pneumatic tired roller was finished and again after the finish roller had completed the rolling sequence. By following this procedure it was possible to determine the effect of the finish roller on the various sites with different pneumatic coverages.

The rollers used on this project were: breakdown, 2-axle tandem, 16,250 lbs.; pneumatic, 26,300 lbs, 11 wheel with 65 psi tire pressure; finish 2-axle tandem, 16,000 lbs.

Air permeameter tests were performed on the six sites after the rolling sequence was completed. Since the readings were unusually high and

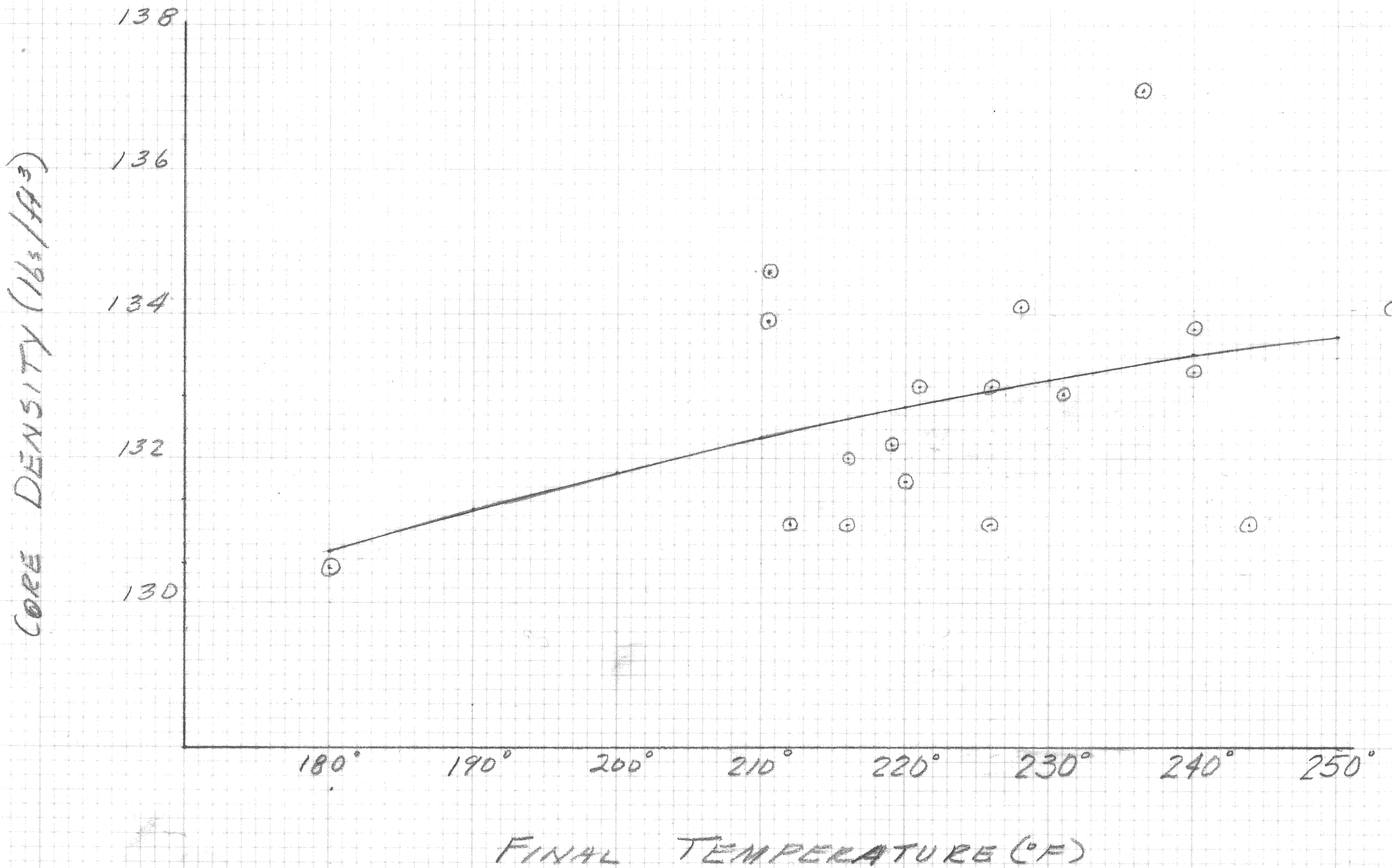


FIGURE 7 — CORE DENSITY VS BREAKDOWN ROLLING TEMPERATURES - Project I-80N-3(34)196

did not vary significantly at the sites, the tests were not considered valid. It was determined that the equipment was not operating properly at that time.

To determine the transverse effect of a normal rolling pattern sequence a series of nuclear density readings with both gages was taken across the existing pavement in one-foot increments. After the final 0.1 ft. layer was constructed a normal rolling pattern was performed by each roller. On each roller pass the distance from the roller to the outside edge of the lane was measured and recorded. Following the finish roller another series of nuclear readings was obtained in one-foot increments. The roller passes were plotted on graph paper to determine the number of passes over each one-foot increment of pavement, and the nuclear density gage readings were compared with the results.

Temperatures were recorded on all of the rolling pattern tests on both construction projects to determine the effect of temperature on the different phases of rolling (i.e., breakdown, pneumatic, and finish rolling).

The rolling sequence tests which were taken on the I-15-2(17)72, Section "B", project indicated that the underlying pavement had a definite effect on the nuclear gages. This effect together with the differences in the specific gravity of the plant mix at the three test sites for each test, made it difficult to obtain a correlation of density during the different phases of the rolling.

These rolling test results are tabulated in Appendix B Tables 22-26. The numbers in parenthesis in Tables 22, 25, and 26 are the core density and air voids for the sites. Rolling tests on Tables 23 and 24 were covered with additional material, which was used to smooth the overpass approaches. These cores were not used for density correlations. The readings were taken about two months before the sites were drilled and the traffic on these sites should have increased the density of the cores.

The last major objective of this project was to determine the transverse variation in plant mix characteristics which were caused by a normal rolling pattern. Figure 8 shows the variation in roller passes and nuclear density readings for each one-foot increment of a 23-foot paving width. The double coverage by the finish roller between the 15 and 20 foot increments was needed to remove a ridge in the pavement made by the first pass of the finish roller. This was a common occurrence throughout the project. The nuclear density results indicate that, over all, there is an increase in density in the areas where the maximum roller coverages occurred. The graph also indicates the variations due to the improper seating of the gages during the tests and a possible variation in the specific gravity of the plant mix at the sites. The nuclear density values shown on the graph were obtained with the Troxler density gage. The Seaman density gage is more sensitive to underlying material and the results were more varied on this 0.1-ft. layer of plant mix.

The data for the I-15-2(17)72 Section B core analysis is listed on Table 7 in Appendix A. Core No. 613 cx was omitted from the data analysis shown in Figure ~~10~~ 9 because the core was cracked when the density was obtained. The standard deviation of the nuclear density readings when compared to the core densities was ±2.10 pcf. There was no significant deviation of the data distribution with the normal distribution curve, based on the P.05 level. The mean was located at -4.6 pcf, which would result in approximately the same density line shift shown in Figure 2 for the I-80N-3(34)196 project. This project had the lowest standard deviation for the data using the Troxler gage.

Air permeameter tests were taken at one-foot increments across the pavement. The test results were extremely high and there was very little deviation in these results at the different sites. This indicated that the air permeameter was not working properly.

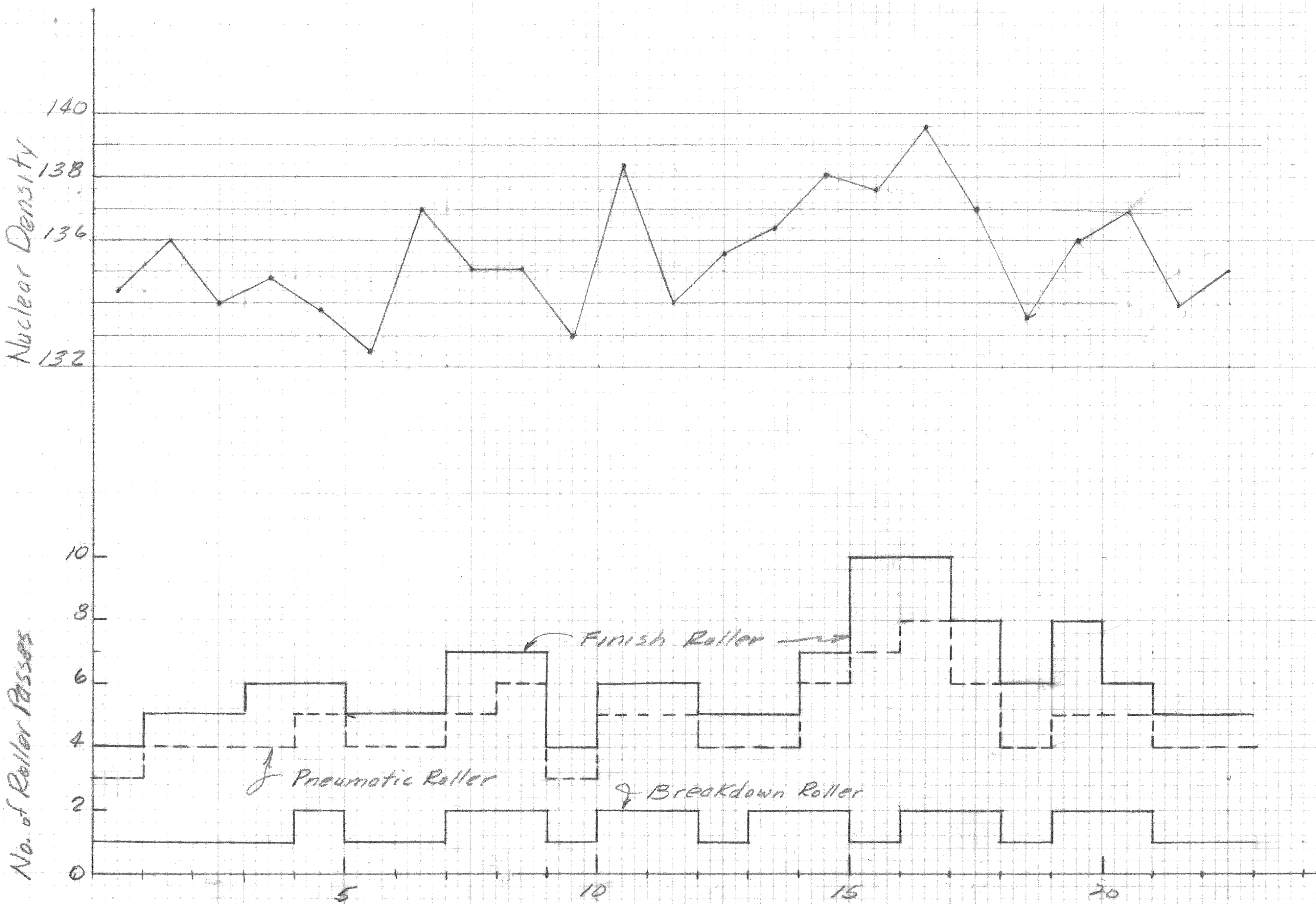


Figure 8- Comparison of Density to Roller Passes.

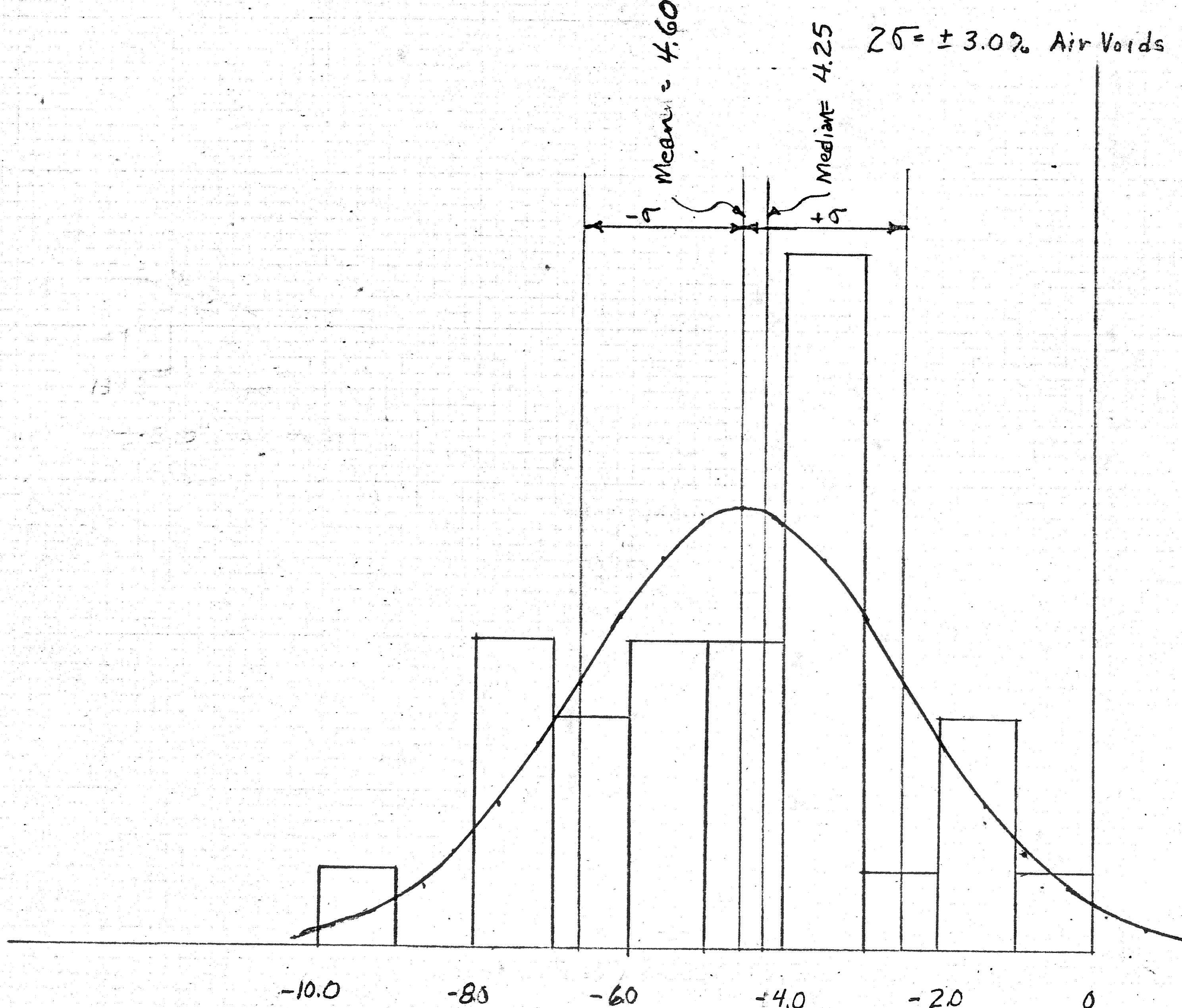
I-15-2(17)72 Sec. B

95% Probability of re~~y~~ccurrence at the 0.05 level

$\sigma = \pm 2.10$ lbs 68% of Value

$2\sigma = \pm 4.20$ lbs 95% of Value

$2\sigma = \pm 3.0\%$ Air Voids



Probability Curve

Troxler Nuclear Gage

FIG. ~~10~~ 9

The final experiment of this research project was a determination of the effects of different plant mixes on the nuclear gages. Troxler nuclear readings, and cores were taken beside the record sample sites on the FL-25(4) project northwest of Stanley and the I-15-2(17)72 Section B project at Blackfoot. The battery on the scaler ran down after the 31st site on the Interstate project. District 3 personnel used the Seaman gage on the S-3712(3) project on SH 19. Density readings and cores were obtained for 18 sites on this project.

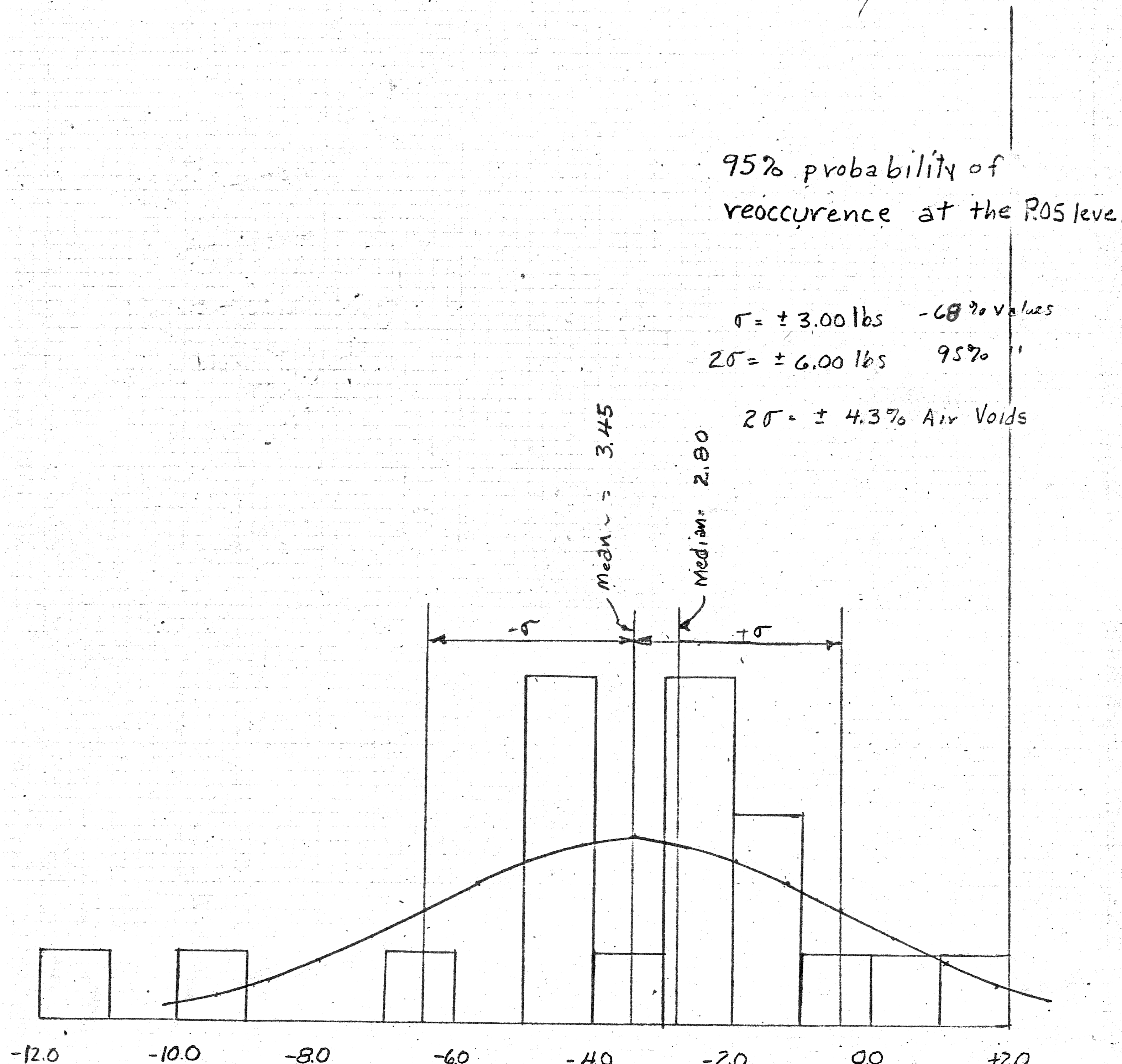
The data for the FL-25(4) project ~~is~~ are listed ~~on~~ in Table 6 in Appendix A. The results of the analysis of the data correlation between the core densities and Troxler readings are shown in Figure ~~9~~ 10. The standard deviation of the nuclear density readings when compared to the core density was ±3.00 pcf. There is no significant deviation between the distribution of data and the normal distribution curve, based on the P.05 level. The mean was located at an approximate value of -3.5 pcf, which indicates the density line on the troxler graph (Figure 2) should be shifted to the right 1.2 pcf less than the I-80N-3(34)196 line on the graph. This project had the highest standard deviation for the data.

The data for the S-3712(3) project ~~is~~ are listed in Table 8 in Appendix A. The standard deviation of the nuclear readings when compared with core densities was ±1.9 pcf. There was no significant deviation of the data from the normal distribution curve at the P.05 level. The mean was located at -0.8 pcf, so there was no adjustment made in the Seaman density graph. The data analysis is shown in Figure 11.

DISCUSSION OF TEST RESULTS

In the control of asphalt pavement construction the primary concern is to keep the air voids within specified limits. The following discussion will be based on a solid density, i.e., no air voids, of 142.9 pcf, which was

FL-25(4)

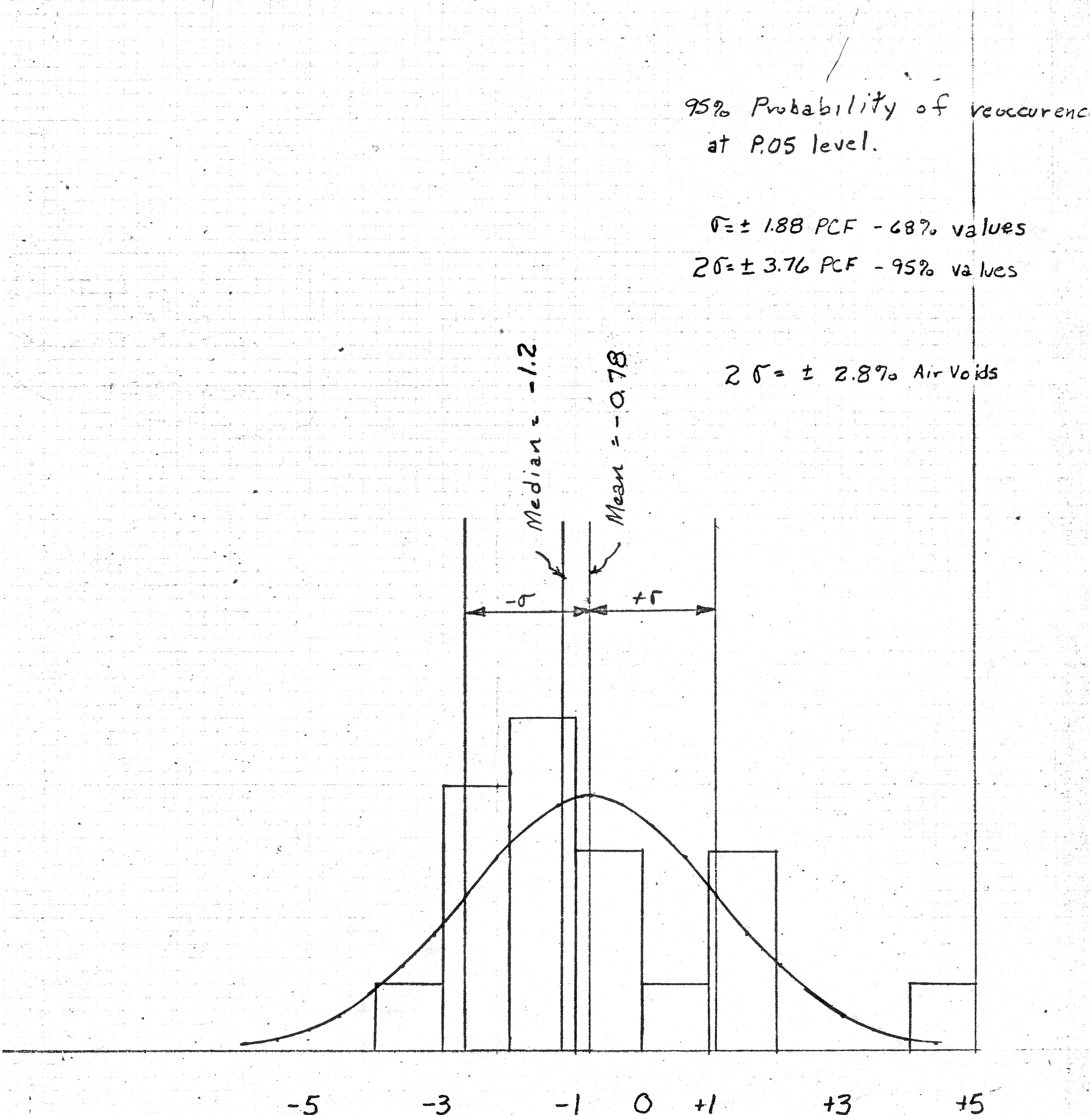


Probability Curve

Troxler Nuclear Gage

FIG. ~~9~~ 10

S-3712(3)



Probability Curve

Seaman Nuclear Gage

FIG. 11

the median core value on the I-80N-3(34)196 project. The air voids range used for analysis will be from 4 to 8 per cent.

On this project 95 per cent of the solid core densities were within ±2.30 pcf of the 142.9 pcf median value. This variation in the core density is the equivalent of ±1.6 per cent air voids. ~~Assuming~~ Using a median air voids value of 6 per cent, the percentage of air voids in the plant mix could vary from 4.4 to 7.6 for a nuclear density reading because of the plant mix density variations.

The standard deviation for the Troxler equipment density readings in comparison to core densities was ±2.19 pcf. Ninety-five per cent, (i.e., two standard deviations) of the readings were within ±4.38 pcf of the corresponding core density values after the adjustment of the factory curve. This variation in readings is the equivalent of ±3.1 per cent air voids using the 142.9 pcf median core value for comparison purposes. The percentage of air voids in the plant mix could vary from 2.9 to 9.1 because of the variations in the density readings.

The standard deviation for the Seaman gage in comparison to the core densities was ±2.58 pcf. Ninety-five per cent of the readings were within ±5.16 pcf of the corresponding core density values. This variation in readings is the equivalent of ±3.6 per cent air voids using the 142.9 pcf median core value. The percentage of air voids could vary from 2.4 to 9.6 because of variations in the density readings.

The analysis of the data in terms of air voids indicates that neither density gage is accurate enough for the 4 to 8 per cent range of air voids. The production control of the plant mix is barely within this range. ~~The~~ Apparent reasons for the variation in the density readings of the nuclear gages are as follows:

1. Improper seating of the gages.

2. "Chemical effect" of the material being tested. (Troxler gage.)

3. Depth of material being tested.

4. Random nature of the radioactive source emission.

5. Voltage variations in the gages during readings. (Troxler gage.)

6. Surface voids not considered in core density.

The first reason accounts for a large ~~amount~~ part of the standard deviation in the readings. With proper training and experience an inspector could reduce the standard deviation in the readings to about ±2.0 pcf with either gage.

The "chemical effects" of the material being tested ~~is~~ appears to be the main reason for the adjustment to the factory curve for the Troxler gage. "Chemical effect" is ~~primarily~~ reportedly a reaction to radiation by some materials, but it also includes such influences as background radiation. The air gap method used by the Seaman gage is intended to reduce~~s~~ the influence of this effect.

The depth of the material being tested definitely has an influence on the density readings. This was apparent on the I-15-2(17)72 Section B project where the depths varied between 0.10 and 0.20 ft. The effect of the underlying material on the I-80N-3(34)196 project was negligible for the 0.20 ft. depth because the underlying material was similar to the material being tested.

The effects of the other three reasons listed above are somewhat minor in nature, but they will have an influence on the readings.

The use of the nuclear density gages to determine an adequate rolling sequence is limited by the gage seating problem. During the pneumatic-tire roller sequence, tire ridges develop in the pavement. These ridges induce air gaps under the gages which influence the density readings. A fine-sand leveling course can be used to eliminate the air gap but the readings are still lower than those obtained on a smooth surface. If the material being tested and the underlying material are reasonably similar in density and "chemical effect," the tests can be performed on different sites which are covered with different rolling sequences, after the finish roller has removed the pneumatic-tire ridges. The accuracy of these tests will be less than that of the nuclear gages because of the variation of the material at the sites.

The study of the rolling temperature effects on final density was primarily inconclusive because of the variations in the nuclear gages, number of roller passes, and the material at the test sites. Three of the four rolling test cores containing the highest percentage of air voids were obtained from rolling sequences, which were performed in the morning. By the time the transverse construction joint was completed, the plant mix temperature had been reduced to the extent that the rolling sequence was not adequately reducing the air voids in the plant mix.

The study of the effect of different plant mixes on the nuclear gages showed the expected results. The FL-25(4) project results indicated that the Troxler gage would have to be calibrated for each plant mix project. The I-80N-3(34)196 and I-15-2(17)72 projects had an average difference between core densities and troxler readings of approximately -4.5 pcf. The corresponding difference for the FL-25(4) project was -3.5 pcf.

For the Seaman gage, the mean value for the I-80N-3(34)196 project was +1.0 pcf, while the same value for the S-3712(3) project was -0.8 pcf. This difference in mean values was primarily due to the fact that the density gage was completely recalibrated between the times that the two projects were tested. The president of the Seaman Nuclear Corporation explained the operation procedures for the gage just before the machine was recalibrated. These procedures were explained to District 3 personnel, who did the testing on the S-3712(3) project.

The Seaman gage apparently does not need to be calibrated for different plant mix projects.

Several studies of the tests results were made to determine if certain correlations existed in the data. A plot of core air voids against nuclear densities was made for all of the projects. No trend was apparent in these plots because of the widely scattered points.

An attempt to establish an air gap for the Troxler gage was made on the I-80N-3(34)196 project. Three air gaps of 1/2, 3/4 and 1 inches were used to establish an air gap ratio for the core densities. There was no apparent relationship between the ratios and the densities for either the 1/2-inch or 3/4-inch air gaps. A trend was established on the 1-inch air gap with 42 per cent of the points being within one standard deviation. This indicates that the most accurate air gap for the gage is between 1 and 1 1/2-inches. More research to establish this gap is necessary. The accuracy of this air gap ratio might be better than the direct "backscatter" readings.

CONCLUSIONS

The use of the Troxler and Seaman density gages for the control of plant mix pavement construction should be considered. The accuracy of the gages in the data analysis is not sufficient to control the percentage of air voids in the plant mix between 4 and 8 per cent. With proper personnel training and experience the accuracy of the gages could be increased to approach the desired levels providing the plant mix production can be controlled to produce a uniform material. Additional research will be required on plant mix pavements of at least 0.2 ft. thickness to validate the accuracy of the gages. The gages do not obtain desired accuracy on thin plant mix overlays.

Air permeameter results indicate ~~the~~ that surface texture of the pavement influences the test readings more than the core density or the core air voids. A small amount of traffic will lower these readings considerably. The use of the air permeameter for the control of plant mix pavement construction is questionable at the present time. Additional research with the equipment should be conducted.

RECOMMENDATIONS

1. Conduct test roll pattern

   a. One breakdown plus three pneumatic plus finish - total 5.

   b. Increase above to give 7 - 9 - 11, etc., total coverages.

   c. Measure density nuclear for each @ finish and plot curve.

   d. Select minimum total coverages where curve is indicated to give 98 per cent plus density of indicated maximum density.

   e. Continue rolling project at number coverages determined by d above.

REFERENCES

(1) "Bituminous Pavement Construction," U. S. Department of Transportation, Federal Highway Administration, Bureau of Public Roads, June 1967.

APPENDIX A

S-3804(3)
TROXLER, SEAMAN, AND PERMEAMETER READINGS
VS
CORE DENSITY AND AIR VOIDS

Job finished before cores

Core No.	Core Density	Core Air Voids	Troxler Density	Seaman Density	Permeameter Readings
1	124.0	13.2	114.5		2419
2	127.0	11.1	118.3		1339
3	130.3	9.2	118.3	123.0	1245
4	131.5	7.6	128.5		554
5	130.4	9.1	125.8	130.0	564
6	129.5	9.4	121.0		583
7	129.2	9.2	129.5		826
8	130.4	7.9	128.5		759
9	127.3	10.9	117.2		1232
10	130.4	8.7	128.5		469
11	129.8	9.2	124.8		1307
12	130.4	9.1	120.0		776
13	128.5	10.5	122.0	123.0	923
14	127.9	10.9	127.5	128.0	1296
15	129.8		124.8		
16	128.5		127.5	125.0	
17	126.7		124.8	125.0	
601-R	130.3		127.5	129.5	
602-R	129.3		123.8	130.0	
603-R	132.5		129.5	129.0	
604-R	130.1		128.5	129.5	
605-R	130.4		127.5	129.5	
606-R	127.5		127.5	127.0	

Table 1

STATE OF IDAHO
I-80N-4(1)220
NUCLEAR DENSITY EQUIPMENT
AND
CORE DENSITY COMPARISON

Core No.	Actual Core Density	Troxler Density	Seaman Density
1	138.9	136.0	139.5
2	139.2	135.0	144.0
3	139.8	135.2	141.5
4	135.1	135.5	132.0
5	140.3	131.7	137.5
6	139.3	124.5	134.0
7	138.0		127.5

Table 2

I-80N-3(34)196

all thru

CLASS "B" PLANT MIX
TEST SITES
CORE RESULTS VS NUCLEAR DENSITY
READINGS

Test Site	Station	Core Density	Air Voids	Troxler Density	Seamans Density
1	714	133.0	6.5%	123.6	131.2
2	690	131.3	8.5%	124.3	127.5
3	666	132.7	7.1%	130.2	135.0
4	641	132.0	7.6%	126.6	130.3
5	610	131.8	7.8%	124.6	130.5
6	581	134.4	6.3%	125.3	130.3
7	557	135.4	7.5%	125.8	135.0
8	533	131.3	9.1%	123.0	135.0
9	508	133.2	7.6%	127.1	135.5
10	474	134.5	5.9%	121.5	131.0
11	449	127.9	10.5%	120.3	131.8
12	425	133.0	7.7%	127.0	
13	419	133.7	6.3%	129.4	
14	444	133.0	6.1%	129.0	
15	468	broken core		127.5	
16	494	134.0	5.3%	128.0	
17	520	135.0	6.8%	130.2	
18	546	134.6	5.4%	129.5	
19	572	135.0	5.5%	126.4	
20	599	130.2	9.3%	126.2	
21	625	broken core		127.2	
22	651	134.9	6.8%	131.0	
23	678	134.3	6.4%	129.3	
24	706	133.7	6.4%	126.6	133.0

Table ~~I~~ 3

I-80N-3(34)196

All Thru

CLASS "D" PLANT MIX
TEST SITES
CORE RESULTS VS NUCLEAR DENSITY
AND
AIR PERMEAMETER READINGS

Test Site	Station	Core Density	Air Voids	Troxler Density	Seamans Density	Permeability Readings
1	714	127.2	10.6%	121.6	127.0	534
2	690	125.7	11.7%	122.5	129.0	768
3	666	127.9	10.5%	127.5	128.0	237
4	641	136.9	4.8%	131.5	133.5	
5	610	128.1	9.5%	127.0	132.5	365
6	581	134.0	5.0%	128.5	134.0	101
7	557	127.8	11.0%	133.0	136.0	72
8	533	broken core		129.0	132.0	161
9	508	131.7	7.5%	130.5	133.2	
10	474	134.6	7.0%	128.4	132.0	186
11	449	130.5	8.7%	127.0	132.5	166
12	425	129.0	9.8%	124.5	129.5	114
13	419	131.1	7.0%	127.5	133.5	137
14	444	134.0	6.2%	129.0	129.0	52
15	468	135.2	5.4%	129.9	136.2	54
16	494	132.6	6.4%	131.7	135.5	
17	520	133.6	7.2%	127.8	133.0	151
18	546	134.2	4.4%	129.5	133.5	
19	572	132.7	5.5%	128.0	133.2	
20	599	132.0	7.2%	132.0	135.0	
21	625	broken core		131.8	135.0	
22	651	134.9	5.4%	133.5	137.5	
23	678	133.7	6.4%	131.2	133.8	
24	706	134.0	5.8%	130.7	133.5	

Table ~~2~~ 4

I-80N-3(34)196

ROLLING TESTS
CORE RESULTS VS NUCLEAR DENSITIES
PERMEABILITY READINGS

Rolling Test	Passes by Each Roller Bkdn	Pneu	Fin	Core Density	Core Air Voids	Troxler Density	Seamans Density	Permeability Readings
1	2	9	1	128.2	10.0	127.2	133.0	
2	2	7	1	132.1	7.3	132.0	137.0	
3	2	7	1	133.8	6.7	130.5	137.5	
4	2	7	1	130.5	8.7	125.2	132.2	
5	2	7	1	131.7	7.1	126.5	133.5	
6	2	7	2	137.0	2.9	131.2	141.2	
7	3	7	2	134.5	4.9	130.3	136,5	
8	4	7	1	132.9	6.5	130.0	132.0	171
9	2	7	1	132.8	7.0	129.0	136.0	178
10	2	7	1	131.1	7.1	127.3	135.8	85
11	2	7	1	133.1	6.5	129.2	135.8	156
12	2	7	1	131.1	8.2	129.0	134.0	72
13	2	7	1	Broken Core		129.0	133.0	166
14	2	7	1	132.0	8.0	128.2	134.5	100
15	2	7	1	134.0	6.6	129.6	133.0	90
16	2	5	1	132.9	6.5	128.2	133.5	67
17	2	5	1	134.0	6.4	129.5	137.0	63
18	2	5	1	Broken Core		129.5	134.0	52
19	2	7	1	131.2	7.1	127.3	131.0	134
20	2	5	1	133.7	5.6	128.3	133.2	150
21	2	5	1	131.1	7.9	126.3	130.0	362
22	2	5	1	Broken Core		128.0	133.5	97
23	2	7	1	Broken Core		127.5	132.0	75
24	2	7	1	132.2	6.4	126.5	131.0	154

Table ~~3~~ 5

APPENDIX B

FL-25(4) ✓
TROXLER READINGS
VS
CORE DENSITY & AIR VOIDS
REFERENCE COUNT = 57,620

Core#	Count	Ratio	Density	Core Density	Core Air Voids
601cx	60,978	1,058	137.2	139.2	8.6
602cx	60,658	1.053	137.6	139.4	8.0
603cx	63,357	1.100	133.2	137.9	9.0
604cx	66,514	1.154	128.2	139.8	8.2
605cx	63,043	1.094	133.7	138.5	8.6
606cx	64,438	1.118	131.5	140.6	6.9
607cx	62,334	1.082	134.8	137.5	8.9
608cx	61,217	1.062	136.8	138.8	8.4
609cx	59,400	1.031	139.8	138.1	8.5
610cx	63,311	1.099	133.3	139.8	7.4
611cx	62,066	1.077	135.5	139.5	8.8
612cx	57,991	1.006	142.5	141.5	6.7
613cx	61,498	1.067	136.5	140.5	7.3
614cx	59,610	1.035	139.5	140.3	7.9
615cx	61,502	1.067	136.5	140.0	8.1
616cx	59,576	1.034	139.5	141.4	6.4
617cx	61,424	1.066	136.5	141.3	7.4
618cx	60,365	1.048	138.2	139.7	7.8
619cx	59,971	1.041	138.7	141.5	7.1
620cx	60,227	1.045	138.5	141.4	7.2

Table 6

I-15-2(17)72 Sec B
TROXLER READINGS
VS
CORE DENSITY & AIR VOIDS
REFERENCE COUNT = 57,660

Core#	Count	Ratio	Density	Core Density	Core Air Voids
601cx	60,618	1.051	137.9	141.2	6.1
602cx	61,983	1.075	135.5	137.5	8.9
603cx	62,318	1.081	135.0	138.2	7.3
604cx	61,470	1.066	136.5	139.6	7.2
605cx	62,691	1.087	134.5	139.0	6.8
606cx	64,396	1.117	131.7	138.3	7.2
607cx	66,170	1.148	128.8	138.4	8.0
608cx	64,436	1.118	131.6	135.5	10.3
609cx	61,736	1.071	136.0	136.8	7.1
610cx	64,506	1.119	131.5	136.1	8.7
611cx	61,939	1.074	135.5	140.3	5.9
612cx	63,370	1.099	133.4	135.7	9.8
613cx*	61,893	1.073	135.8	132.9	11.3
614cx	63,280	1.097	133.6	136.7	8.3
615cx	64,124	1.112	132.0	140.0	6.1
616cx	61,676	1.070	136.0	139.7	6.7
617cx	60,521	1.050	138.0	139.4	6.5
618cx	63,924	1.109	132.5	139.5	7.2
619cx	61,970	1.075	135.7	139.7	6.7
620cx**	62,756	1.094	133.7	139.2	7.4
621cx	61,481	1.072	135.9	141.8	6.1
622cx	63,425	1.105	132.8	139.8	7.4
623cx	61,588	1.073	135.8	140.1	6.8

* Cracked Core
** New Reference Count = 57,376

Table 7

I-15-2(17)72 Sec B
Page 2 (Cont.)
REFERENCE COUNT = 57,376

Core#	Count	Ratio	Density	Core Density	Core Air Voids
624cx	61,753	1.076	135.5	141.5	6.7
625cx	61,068	1.064	136.6	140.0	6.5
626cx	61,814	1.077	135.5	139.0	7.6
627cx	64,072	1.117	131.8	139.1	7.9
628cx	60,014	1.048	138.3	140.2	7.2
629cx	62,492	1.089	134.2	141.6	5.9
630cx	62,609	1.091	134.0	139.7	7.1
631cx	63,211	1.102	133.0	141.0	6.2

Table 7 (con't)

S-3712(3)
NUCLEAR DENSITY READINGS
AND
CORE DENSITY & AIR VOIDS COMPARISON

SH 19

Core #	Core Density	Core Air Voids	Seaman Density
1	133.5	10.9	134.8
2	137.3	8.3	134.7
3	136.7	8.7	134.9
4	134.8	9.6	134.9
5	134.8	9.2	131.2
6	135.4	9.9	133.6
7	134.1	9.7	135.1
8	137.3	8.4	141.7
9	135.4	9.6	134.3
10	135.4	9.6	136.6
11	137.3	7.9	136.7
12	135.4	9.6	133.1
13	134.1	12.3	133.9
14	133.5	10.5	132.5
15	134.8	10.4	132.1
16	136.1	8.1	134.0
17	137.3	8.3	136.8
18	135.4	8.9	134.0

Table 8

ROLLING TESTS
I-80N-3(34)196 Sec. A
REFERENCE COUNT = 57,935

Roller Test #1 - Station 653+40 EBL

Roller	Passes	Reading	Ratio	Density	Temp. °F
Breakdown	2	68,864	1.189	125.0	
Pneumatic	2	71,864	1.240	120.0	175
Pneumatic	3	72,240	1.247	119.5	175
Pneumatic	4	71,379	1.232	120.7	170
Pneumatic	5	70,193	1.212	122.7	165
Pneumatic	7	70,188	1.212	122.7	160
Pneumatic	9	69,092	1.193	124.5	155
Finish		67,374	1.163	127.2	125

Roller Test No. 2 - Station 634+30 EBL

Roller	Passes	Reading	Ratio	Density	Temp. °F
Breakdown	2	70,424	1.216	122.4	
Pneumatic	2	69,271	1.200	123.7	220
Pneumatic	3	70,553	1.217	122.4	215
Pneumatic	4	70,106	1.210	122.9	215
Pneumatic	5	67,261	1.161	127.5	210
Pneumatic	7	67,156	1.159	127.7	200
Finish		64,432	1.112	132.0	140

Table 9

ROLLING TESTS
I-80N-3(34)196 Sec. A
Cont.

Roller Test #3 - Station 617+20 EBL

Roller	Passes	Reading	Ratio	Density	Temp. °F
Breakdown	1	70,988	1.225	121.5	210
Breakdown	2	69,394	1.198	124.0	210
Pneumatic	2	69,452	1.199	124.0	205
Pneumatic	3	70,567	1.218	122.2	200
Pneumatic	4	69,963	1.208	123.0	200
Pneumatic	5	68,698	1.186	125.2	200
Pneumatic	7	66,636	1.150	128.5	200
Finish		65,382	1.129	130.5	200

Table 10

ROLLING TEST
I-80N-3(34)196 Sec. A
REFERENCE COUNT = 57,437

Roller Test #4 - Station 588 +50 EBL

Roller	Passes	Reading	Ratio	Density	Temp. °F
Breakdown	2	69,136	1.204	123.4	180
Pneumatic	2	71,680	1.248	119.5	120
Pneumatic	3	71,517	1.245	119.7	120
Pneumatic	4	70,388	1.225	121.5	115
Pneumatic	5	71,777	1.250	119.0	115
Pneumatic	7	71,384	1.243	119.8	115
Finish	1	68,001	1.184	125.2	100

Roller Test #5 - Station 568 +70 EBL

Roller	Passes	Reading	Ratio	Density	Temp. °F
Breakdown	1	72,786	1.267	117.7	235
Breakdown	2	71,163	1.239	120.2	220
Pneumatic	2	73,007	1.271	117.0	195
Pneumatic	3	70,524	1.228	121.2	195
Pneumatic	4	68,986	1.201	123.5	190
Pneumatic	5	69,786	1.215	122.4	190
Pneumatic	7	68,565	1.194	124.3	185
Finish	1	67,505	1.175	126.5	160

ROLLING TEST
I-80N-3(34)196 Sec. A
(Cont.)

Roller Test #6 Station 549 +50 EBL

Roller	Passes	Reading	Ratio	Density	Temp. °F
Breakdown	1	70,417	1.226	121.5	235
Breakdown	2	68,080	1.185	125.3	235
Pneumatic	2	69,222	1.203	123.3	225
Pneumatic	3	67,132	1.169	126.8	210
Pneumatic	4	67,463	1.175	126.2	205
Pneumatic	5	68,796	1.198	124.0	205
Pneumatic	6	68,934	1.200	123.6	200
Pneumatic	7	67,600	1.177	126.0	195
Finish	1	65,700	1.144	129.2	150
Finish	2	64,382	1.121	131.2	140

Roller Test #7 Station 531 +50 EBL

Roller	Passes	Reading	Ratio	Density	Temp. °F
Breakdown	1	72,481	1.262	118.0	230
Breakdown	2	70,174	1.222	121.7	215
Breakdown	3	69,226	1.205	123.3	210
Pneumatic	2	69,184	1.205	123.3	200
Pneumatic	3	67,966	1.183	125.3	200
Pneumatic	4	67,698	1.180	125.7	200
Pneumatic	5	68,917	1.200	123.6	200
Pneumatic	7	67,437	1.174	126.3	195
Finish	1	65,094	1.133	130.0	140
Finish	2	64,989	1.131	130.3	140

ROLLING TEST
I-80N-3(34)196 Sec A
REFERENCE COUNT - 57,654

Station 481 EBL ROLLING TEST #8

Roller	Passes	Temp	Time	Troxler	Ratio	Density	Permeameter	Ml/Min
Breakdown	2	257	9:00	69,567	1.207	123.2		
Breakdown	3	252	9:05	69,781	1.210	123.0		
Breakdown	4	220	9:30	68,564	1.189	125.0		
Pneumatic	1	200	9:53	67,959	1.179	126.0		
Pneumatic	2	200	9:57					
Pneumatic	3	195	10:00	67,203	1.166	127.0	$\frac{300m(60)}{(28.5)}$	= 632(567)
Pneumatic	5	190	10:06	67,123	1.164	127.3	$\frac{300ml(60)}{78.8}$	= 228(205)
Pneumatic	6	183	10:15					
Pneumatic	7	180	10:18	67,384	1.169	126.9	$\frac{300ml(60.0)}{92.5}$	= 195(177)
Finish	1	140	11:35	65,359	1.134	130.0	$\frac{300ml(60)}{99.0}$	= 182(171)
Station 446 + 50 EBL ROLLING TEST #9								
Breakdown	1	235	1:17	70,813	1.228	121.2		
Breakdown	2	230	1:23	68,679	1.191	124.5		
Pneumatic	1	205	1:38	69,380	1.203	123.4		
Pneumatic	2	205	1:40					
Pneumatic	3	200	1:42	70,866	1.229	121.2	$\frac{300ml(60)}{(22.2)}$	= 811(725)
Pneumatic	4	200						
Pneumatic	5	200	1:47	69,730*	1.209	123.0	$\frac{300(60)}{32.8}$	= 549(492)
Pneumatic	6	193	1:53					
Pneumatic	7	190	1:56	67,821*	1.176	126.1	$\frac{300(60)}{93.6}$	= 192(173)
Finish	1	130	4:34	66,129*	1.147	129.0	$\frac{300ml(60)}{95.5}$	= 188(178)

* Sand used for site leveling purposes.

ROLLING TESTS
I-80N-3(34)196 Sec A
Page 2

Station 471 EBL ROLLING TEST #10

Roller	Passes	Temp	Time	Troxler	Ratio	Density	Temp	Permeameter	Ml/Min
Breakdown	1	217	9:58						
Breakdown	2	215	9:59	69,652	1,216	122.5			
Pneumatic	1	200	10:10	68,377	1.194	124.3	195	300ml(60) / 89.1	= 202 (181)
Pneumatic	2	190	10:16						
Pneumatic	3	190	10:18	68,675*	1.199	124.0	190	200ml(60) / 102.0	= 118 (106)
Pneumatic	4	180	10:27						
Pneumatic	5	178	10:29	66,991*	1.170	126.6	178	200(60) / 99.0	= 121 (110)
Pneumatic	6	170	10:36						
Pneumatic	7	170	10:36	67,201*	1.173	126.3	170	100(60) / 75.0	= 80 (73)
Finish	1	165	10:42	66,588*	1.162	127.3		100(60) / 65.2	= 92 (85)

Station 457 EBL ROLLING TEST #11

Roller	Passes	Temp	Time	Troxler	Ratio	Density	Temp	Permeameter	Ml/Min
Breakdown	1	238	11:23						
Breakdown	2	238	11:25	68,803	1.201	123.5			
Pneumatic	1	216	11:34	69,175	1.208	123.2			
Pneumatic	2	213	11:37						
Pneumatic	3	209	11:39	66,316*	1.158	127.8	205	300ml(60) / 130.2	= 138 (123)
Pneumatic	4	195	11:50						
Pneumatic	5	193	11:53	66,097*	1.154	128.1	190	200ml(60) / 124.2	= 97 (87)
Pneumatic	6	175	12:04						
Pneumatic	7	175	12:04	66,970*	1.169	126.8	175	100ml(60) / 68.9	= 87 (79)
Finish	1	173	12:13	65,473*	1.143	129.2	173	100ml(60) / 35.0	= 171 (156)

* Sand used for Site Leveling Purposes

ROLLING TESTS
I-80N-3(34)196 Sec A
REFERENCE COUNT - 57,281

Station 447 EBL ROLLING TEST #12

Roller	Passes	Temp	Time	Troxler	Ratio	Density	Temp	Permeameter	Ml/Min
Breakdown	1	225	12:42						
Breakdown	2	225	12:42	71,369	1.246	119.5			
Pneumatic	1	182	1:07	69,652	1.216	122.4	180	300ml(60) / 80.5	= 224 (203)
Pneumatic	2	178	1:12						
Pneumatic	3	178	1:13	67,777*	1.183	125.4	175	300ml(60) / 87.5	= 206 (188)
Pneumatic	4	172	1:20						
Pneumatic	5	172	1:21	67,929*	1.186	125.3	168	100ml(60) / 64.8	= 93 (85)
Pneumatic	6	165	1:28						
Pneumatic	7	165	1:29	66,548*	1.162	127.2	160	100(60) / 54.7	= 110 (101)
Finish	1	136	2:30	65,646*	1.146	129.0	135	100(60) / 78.0	= 77 (72)

*Sand used for Site Leveling Purposes

Table 15

ROLLING TESTS
I-80N-3(34)196 Sec A
REFERENCE COUNT - 57,554

Station 481 WBL ROLLING TEST #13

Roller	Passes	Temp	Time	Troxler	Ratio	Density	Temp	Permeameter		Ml/Min
Breakdown	1	218								
Breakdown	2	218	9:09	69,933	1.215	122.5				
Breakdown	3	203	9:17	69,480	1.213	122.5				
Pneumatic	1	145	10:12	67,982	1.181	125.6	145	300ml(60) / 24.6	=	732 (683
Pneumatic	3	140	10:16	67,361	1.170	126.6	140	300ml(60) / 101.6	=	177 (166
Pneumatic	5	140	10:24	67,166	1.167	127.0	135	300ml(60) / 79.2	=	227 (214
Pneumatic	7	135	10:31	65,939	1.146	129.0	135	300ml(60) / 97.9	=	184 (173
Finish	1	130	10:50	66,073	1.148	129.0	130	300ml(60) / 102.5	=	176 (166
Station 455 WBL ROLLING TEST #14										
Breakdown	1	222	11:52							
Breakdown	2	215	11:56	70,105	1.218	122.2				
Pneumatic	1	200	12:07	69,908	1.215	122.5	195	300ml(60) / 50.5	=	356 (319)
Pneumatic	2	190	12:13							
Pneumatic	3	188	12:14	69,161	1.202	123.5	184	300ml(60) / 79.8	=	226 (204)
Pneumatic	4	182	12:20							
Pneumatic	5	180	12:21	68,142	1.184	125.5	177	300ml(60) / 120.4	=	150 (136)
Pneumatic	6	172	12:32							
Pneumatic	7	170	12:35	67,431*	1.172	126.3	168	200(60) / 117.8	=	102 (93)
Finish	1	138	2:02	66,408*	1.154	128.2	138	200(60) / 112.0	=	107 (100)

*Sand used for Site Leveling Purposes

ROLLING TESTS
I-80N-3(34)196 Sec A
Page 2

Station 431 + 50 WBL ROLLING TEST #15

Roller	Passes	Temp	Time	Troxler	Ratio	Density	Temp	Permeameter		Ml/Min
Breakdown	1	255	2:37							
Breakdown	2	252	2:38	69,359	1.205	123.3				
Pneumatic	1	212	2:57	69,683	1.211	122.7				
Pneumatic	2	192	3:08							
Pneumatic	3	190	3:11	68,112*	1.183	125.5	185	300ml(60 / 68.7	=	262 (237)
Pneumatic	4	180	3:20							
Pneumatic	5	176	3:22	67,416*	1.171	126.5	173	300ml(60) / 112.5	=	160 (146)
Pneumatic	6	170	3:22							
Pneumatic	7	170	3:33	67,133*	1.166	127.0	167	300(60) / 111.8	=	161 (148)
Finish	1	160	3:48	65,554*	1.139	129.6	158	200(60) / 124.2	=	97 (90)

*Sand used for Site leveling Purposes

ROLLING TESTS
I-80N-3(34)196 Sec A
REFERENCE COUNT - 57,716

Rolling Tests - Station 521 + 70 ROLLING TEST #16

Roller	Passes	Time	Temp.	Troxler	Ratio	Density	Temp.	Permeameter	Ml/Min.
Breakdown	1	9:52	228						
Breakdown	2	9:54	225	68,004	1.178	126.0			
Pneumatic	1	10:13	195	68,269	1.183	125.5	193	$\frac{200(60)}{60.7}$	= 198(178)
Pneumatic	2	10:21	190						
Pneumatic	3	10:22	190	68,086	1.180	125.7	185	$\frac{100(60)}{85.3}$	= 70(63)
Pneumatic	4	10:28	178						
Pneumatic	5	10:29	177	67,599	1.171	126.5	175	$\frac{100(60)}{89.5}$	= 67(61)
Finish	1	11:40	140	66,533	1.153	128.2	140	$\frac{100(60)}{83.4}$	= 72(67)

Station 493 + 50 ROLLING TEST #17

Roller	Passes	Time	Temp.	Troxler	Ratio	Density	Temp.	Permeameter	Ml/Min.
Breakdown	1	12:25	228						
Breakdown	2	12:26	227	68,598	1.189	125.0			
Pneumatic	1	12:42	200	68,741	1.191	124.5	197	$\frac{300(60)}{84.3}$	= 214(192)
Pneumatic	2	12:52	190						
Pneumatic	3	12:58	185	68,392	1.185	125.2	187	$\frac{200(60)}{60.0}$	= 200(181)
Pneumatic	4	1:05	177						
Pneumatic	5	1:07	177	67,345	1.167	127.0	176	$\frac{100(60)}{59.1}$	= 102(93)
Finish	1	2:07	150	65,823	1.140	129.5	150	$\frac{100(60)}{88.6}$	= 68(63)

Station 585 ROLLING TEST #18

Roller	Passes	Time	Temp.	Troxler	Ratio	Density	Temp.	Permeameter	Ml/Min.
Breakdown	1	2:53	233						
Breakdown	2	2:54	231	68,921	1.194	124.2			
Pneumatic	1	3:04	217	69,722	1.208	123.2		hot	
Pneumatic	2	3:09	212						
Pneumatic	3	3:11	210	68,559*	1.188	125.0	207	$\frac{100(60)}{65.4}$	= 92(82)
Pneumatic	4	3:19	205						
Pneumatic	5	3:23	202	71,185*	1.233	120.7	195	$\frac{75(60)}{121.0}$	= 37(33)
Finish	1	4:16	170	65,951*	1.143	129.5	170	$\frac{100(60)}{\text{[illegible]}}$	= 57(52)

*Sand used for Site Leveling Purposes

ROLLING TESTS
I-80N-3(34)196 Sec A
Page 2

Station 569 + 20 ROLLING TEST #19

Roller	Passes	Time	Temp.	Troxler	Ratio	Density	Temp.	Permeameter	Ml/Min
Breakdown	1	4:59	242						
Breakdown	2	5:00	242	70,034	1.213	122.5			
Pneumatic	1	5:10	225	72,833*	1.262	118.0	220	300(160) / 57.0	= 316(278)
Pneumatic	2	5:21	212						
Pneumatic	3	5:22	212	70,164*	1.216	122.3	208	200(60) / 90.5	= 133(118)
Pneumatic	4	5:33	202						
Pneumatic	5	5:35	200	68,846*	1.193	124.5	197	200(60) / 60.6	= 198(177)
Pneumatic	6	5:49	188						
Pneumatic	7	5:50	188	69,125*	1.198	124.0	185	200(60) / 70.5	= 170(154)
Finish	1	7:47	138	67,154*	1.164	127.3	138	200(60) / 84.0	= 143(134)

REFERENCE COUNT 57,958
Station 588 + 50 ROLLING TEST #20

Roller	Passes	Time	Temp.	Troxler	Ratio	Density	Temp.	Permeameter	Ml/Min
Breakdown	1	12:00	240						
Breakdown	2	12:02	238	67,815	1.170	126.5			
Pneumatic	1	12:33	184	68,793	1.187	125.0	182	300(60) / 52.4	= 344(312)
Pneumatic	2	12:40	178						
Pneumatic	3	12:44	174	67,988	1.173	126.3	171	300(60) / 58.5	= 308(282)
Pneumatic	4	12:49	168						
Pneumatic	5	12:52	165	67,688	1.168	127.0	163	300(60) / 78.0	= 231(213)
Finish	1	2:29	130	66,893	1.154	128.3	130	300(60) / 113.5	= 159(150)

*Sand used for Site Leveling Purposes

ROLLING TESTS
I-80N-3(34)196 Sec A
REFERENCE COUNT - 57,734

Rolling Tests - Station 446 + 40 ROLLING TEST #21

Roller	Passes	Time	Temp	Troxler	Ratio	Density	Temp	Permeameter	Ml/Min
Breakdown	1	9:00	212						
Breakdown	2	9:02	212	69,817	1.209	123.0			
Pneumatic	1	9:28	165	69,867	1.210	123.0	163	300(60)/41.8	= 431(397)
Pneumatic	2	9:42	150						
Pneumatic	3	9:46	148	69,383	1.202	123.5	146	300(60)/59.1	= 305(285)
Pneumatic	4	9:54	142						
Pneumatic	5	10:01	140	70,657	1.224	121.5	138	300(60)/66.9	= 269(253)
Finish	1	11:19	128	67,747	1.173	126.3	128	300(60)/47.1	= 382(362)

Station 521 + 50 ROLLING TEST #22

Roller	Passes	Time	Temp	Troxler	Ratio	Density	Temp	Permeameter	Ml/Min
Breakdown	1	11:56	234						
Breakdown	2	11:57	232	69,701	1.207	123.2			
Pneumatic	1	12:12	205	70,721	1.225	121.5			
Pneumatic	2	12:26	190						
Pneumatic	3	12:27	190	69,187	1.198	124.0	186	300(60)/122.1	= 147(133)
Pneumatic	4	12:43	178						
Pneumatic	5	12:45	175	69,543	1.205	123.3	173	300(60)/94.0	= 192(175)
Pneumatic	6	12:52	172						
Pneumatic	7	12:56	170	68,271	1.183	125.5	170	200(60)/96.0	= 125(114)
Finish	1	2:25	152	66,795	1.156	128.0	150	200(60)/115.3	= 104(97)

ROLLING TESTS
I-80N-3(34)196 Sec A
REFERENCE COUNT - 57,734

Rolling Tests - Station 498 ROLLING TEST #23

Roller	Passes	Time	Temp.	Troxler	Ratio	Density	Temp.	Permeameter		Ml/Min.
Breakdown	1	3:20	241							
Breakdown	2	3:21	240	72,003	1.247	119.5				
Pneumatic	1	3:27	232	71,897	1.245	119.5				
Pneumatic	2	3:35	219							
Pneumatic	3	3:36	218	71,567	1.240	120.0				
Pneumatic	4	3:43	211							
Pneumatic	5	3:44	210	69,799	1.209	123.0	208	$\frac{200(60)}{78.2}$	=	153(136)
Pneumatic	6	3:54	202							
Pneumatic	7	3:55	200	69,360	1.201	123.5	197	$\frac{200(60)}{102.1}$	=	118(106)
Finish	1	6:44	143	66,951	1.160	127.5	142	$\frac{100(60)}{74.6}$	=	80(75)

REFERENCE 57,851
Station 508 + 70 ROLLING TEST #24

Roller	Passes	Time	Temp.	Troxler	Ratio	Density	Temp.	Permeameter		Ml/Min.
Breakdown	1	10:47	222							
Breakdown	2	10:48	218	69,481	1.201	123.5				
Pneumatic	1	11:17	185	71,522	1.236	120.5	175	$\frac{300(60)}{47.3}$	=	381(347)
Pneumatic	2	11:27	165							
Pneumatic	3	11:29	162	69,751	1.206	123.2	160	$\frac{300(60)}{95.1}$	=	189(174)
Pneumatic	4	11:38	160							
Pneumatic	5	11:41	158	69,373	1.199	123.7	156	$\frac{300(60)}{62.8}$	=	287(266)
Pneumatic	6	11:48	152							
Pneumatic	7	11:51	152	69,831	1.207	122.5	152	$\frac{300(60)}{78.0}$	=	231(215)
Finish	1	1:08	144	67,759	1.171	126.5	144	$\frac{300(60)}{108.8}$	=	165(154)

Table 21

ROLLING TESTS
I-15-2(17)72 Sec. B
STATION 1128
REFERENCE COUNT 57,782

	TIME	TEMP	POINT A		POINT B		POINT C	
0.10' Pmx			Troxler Density	Seaman Density	Troxler Density	Seaman Density	Troxler Density	Seaman Density
Old Pavement			135.8	140.0				
Laydown	9:11	225						
1 Breakdown	9:15	220	131.0					
2 Breakdown	9:18	217	134.8					
1 Pneu	9:22	210						
2 Pneu	9:22	210						
3 Pneu	9:22	210	134.2	139.5				
4 Pneu	9:48	165						
5 Pneu	9:50	165			124.5	132.0		
6 Pneu	9:51	165						
7 Pneu	9:52	165					125.2	133.0
Finish	10:16	135	134.8	140.5	124.5	131.5	127.0	134.0
			(142.0 - 4.8)		(136.5 - 8.9)		(138.7 - 7.4)	
0.20' Pmx								
Laydown	9:04	240						
Breakdown	9:09	235	126.0	131.0				
1 Pneu	9:33	165						
2 Pneu	9:34	165						
3 Pneu	9:34	165	120.0	133.0				
4 Pneu	9:38	160						
5 Pneu	9:40	160			124.2	134.2		
6 Pneu	9:41	158						
7 Pneu	9:43	155					128.2	136.2
1 Finish	10:20	130						
2 Finish	10:22	130	130.2	136.0	128.2	136.0	132.0	140.5
			(136.8 - 9.0)		(138.6 - 8.2)		(137.3 - 8.7)	

Table 22

ROLLING TESTS
I-15-2(17)72 Sec. B
STATION 1230
REFERENCE COUNT 57,782

	TIME	TEMP	POINT A		POINT B		POINT C	
0.1' Pmx			Troxler Density	Seaman Density	Troxler Density	Seaman Density	Troxler Density	Seaman Density
Old Pavement			134.3	137.0				
Laydown	2:42	235						
Breakdown	2:43	234	127.5	133.0				
1 Pneu	3:01	218						
2 Pneu	3:01	218						
3 Pneu	3:02	217	128.0	136.0				
4 Pneu	3:03	215						
5 Pneu	3:04	215			129.2	137.2		
6 Pneu	3:04	214						
7 Pneu	3:04	214					127.5	134.2
Finish	4:00	150	129.0	136.5	131.0	139.0	130.0	140.5
0.20' Pmx								
Laydown	2:26	235						
Breakdown	2:36	224	123.2	131.5				
1 Pneu	2:57	189						
2 Pneu	2:58	188						
3 Pneu	2:58	188	123.5	131.5				
4 Pneu	2:59	186						
5 Pneu	2:59	186			128.3	136.0		
6 Pneu	3:00	185						
7 Pneu	3:00	185					128.0	138.0
Finish	4:02	150	131.0	135.0	131.2	138.0	132.5	137.5

Table 23

ROLLING TESTS
I-15-2(17)72 Sec. B
STATION 1195
REFERENCE COUNT 58,118

	TIME	TEMP	POINT A		POINT B		POINT C	
0.1' Pmx			Troxler Density	Seaman Density	Troxler Density	Seaman Density	Troxler Density	Seaman Density
Old Pavement			137.5	140.5				
Laydown	9:06	220						
Breakdown	9:17	180	124.2	131.2				
1 Pneu	9:32	155						
2 Pneu	9:32	155						
3 Pneu	9:33	153	125.0	128.0				
4 Pneu	9:34	153						
5 Pneu	9:34	153			129.0	135.2		
6 Pneu	9:35	150						
7 Pneu	9:35	150					127.2	134.5
Finish	10:03	135	128.7	131.0	130.0	136.0	131.5	136.2
0.1' Pmx								
Laydown	8:56	220						
Breakdown	9:15	150	126.2	134.2				
1 Pneu	9:28	120						
2 Pneu	9:29	120						
3 Pneu	9:29	120	125.5	130.8				
4 Pneu	9:30	120						
5 Pneu	9:30	120			126.2	131.0		
6 Pneu	9:31	120						
7 Pneu	9:31	120					127.8	127.0
Finish	10:10	105	128.2	132.0	129.8	132.5	128.3	130.5

Table 24

ROLLING TESTS
I-15-2(17)72 Sec. B
STATION 1040
REFERENCE COUNT 58,248

	TIME	TEMP	POINT A		POINT B		POINT C	
0.1' Pmx			Troxler Density	Seaman Density	Troxler Density	Seaman Density	Troxler Density	Seaman Density
Old Pavement			140.5					
Laydown	10:52	240						
Breakdown	11:06	210	127.5	132.3				
1 Pneu	11:16	195						
2 Pneu	11:17	195						
3 Pneu	11:18	195	127.0	135.0				
4 Pneu	11:20	190						
5 Pneu	11:20	190			127.5	133.0		
6 Pneu	11:21	188						
7 Pneu	11:21	188					128.5	136.0
Finish	1:03	140	130.0	137.2	127.8	136.0	131.0	136.0
			(140.5 - 5.8)		(140.2 - 6.4)		(141.3 - 5.7)	
0.1' Pmx								
Laydown	10:45	237						
Breakdown	11:01	211	123.7	133.0				
1 Pneu	11:12	193						
2 Pneu	11:13	192						
3 Pneu	11:13	192	124.3	131.8				
4 Pneu	11:14	191						
5 Pneu	11:14	191			128.0	133.2		
6 Pneu	11:15	190						
7 Pneu	11:15	190					127.0	133.2
Finish	1:08	140	128.0	135.0	129.0	136.0	129.0	134.0
			(139.0 - 7.6)		(135.0 - 10.2)		(135.2 - 9.3)	

Table 25

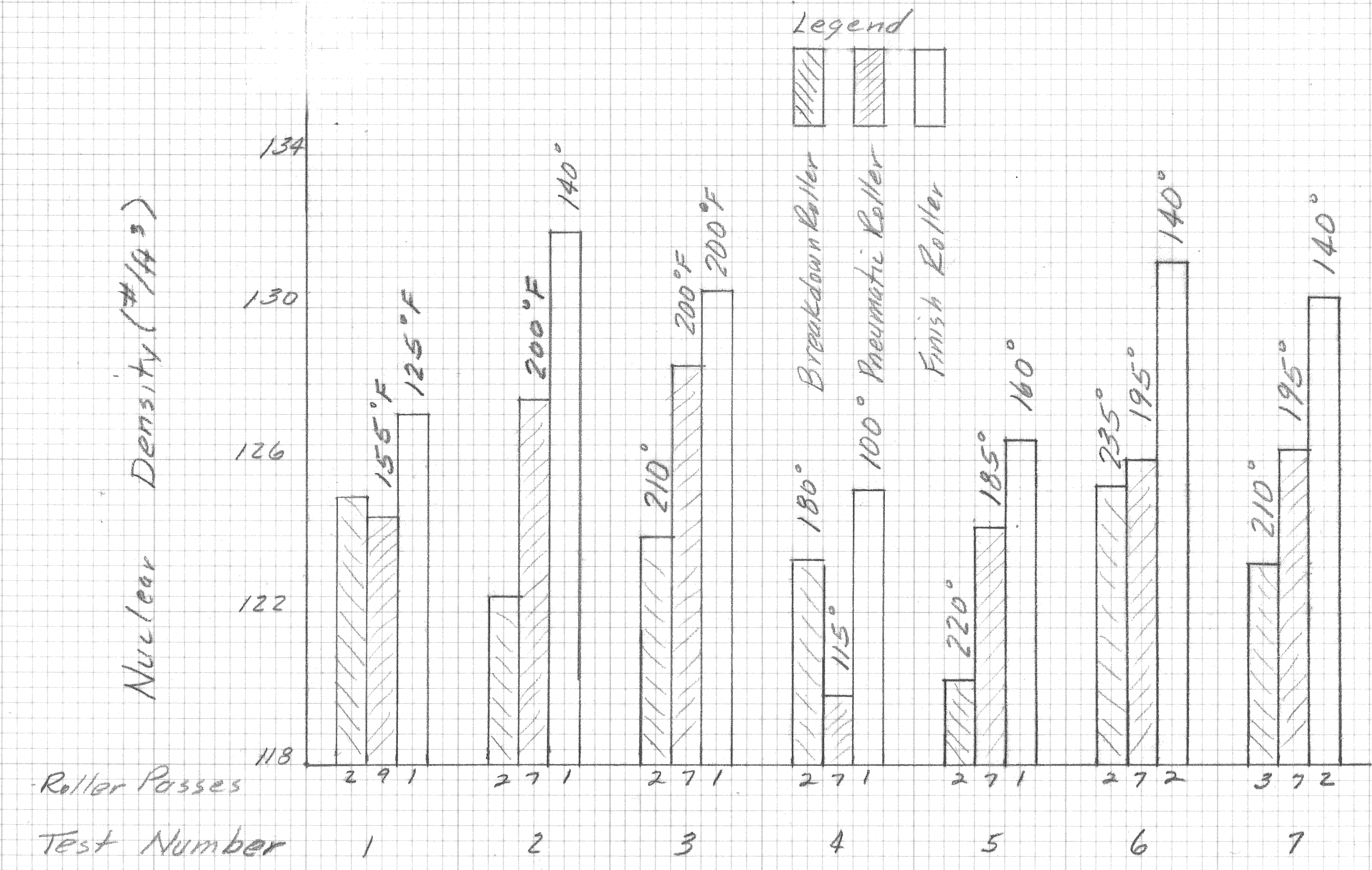
ROLLING TESTS
I-15-2(17)72 Sec. B
STATION 702
REFERENCE COUNT 58,071

0.15' Pmx	TIME	TEMP	POINT A Troxler Density	POINT A Seaman Density	POINT B Troxler Density	POINT B Seaman Density	POINT C Troxler Density	POINT C Seaman Density
ld Pavement			142.0	146.5				
aydown	11:04	230						
reakdown	11:07	222	128.2	136.5				
Pneu	11:29	170						
Pneu	11:30	169						
Pneu	11:31	168	129.5	134.0				
Pneu	11:32	167						
Pneu	11:32	167			129.5	136.0		
Pneu	11:33	166						
Pneu	11:33	166					129.2	135.0
inish	12:18	145	131.0	134.5	130.0	138.0	131.8	137.0
			(140.6 - 6.1)		(141.1 - 6.6)		(139.8 - 7.0)	

0.15' Pmx	TIME	TEMP	POINT A Troxler Density	POINT A Seaman Density	POINT B Troxler Density	POINT B Seaman Density	POINT C Troxler Density	POINT C Seaman Density
ld Pavement			137.5	140.5				
aydown	10:58	230						
Breakdown	11:04	215						
Breakdown	11:07	202	126.0	133.0				
Pneu	11:25	167						
Pneu	11:26	166						
Pneu	11:27	166	127.5	136.0				
Pneu	11:28	165						
Pneu	11:28	165			129.5	134.0		
Pneu	11:29	165						
Pneu	11:29	165					128.0	135.0
inish	12:25	145	131.7	134.5	130.3	136.2	131.0	135.2
			(138.5 - 7.9)		(138.3 - 8.4)		(137.4 - 9.4)	

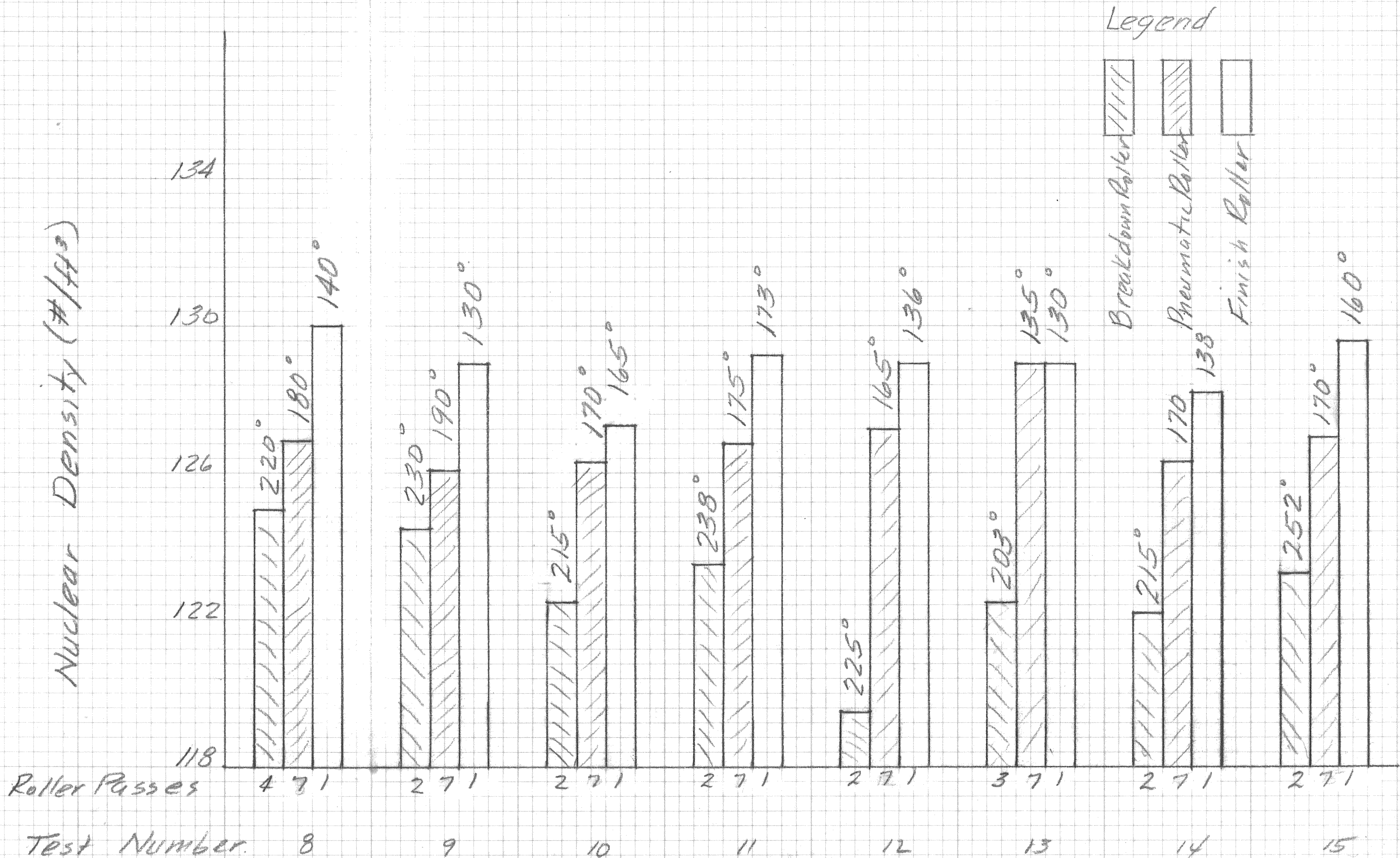
Table 26

APPENDIX C



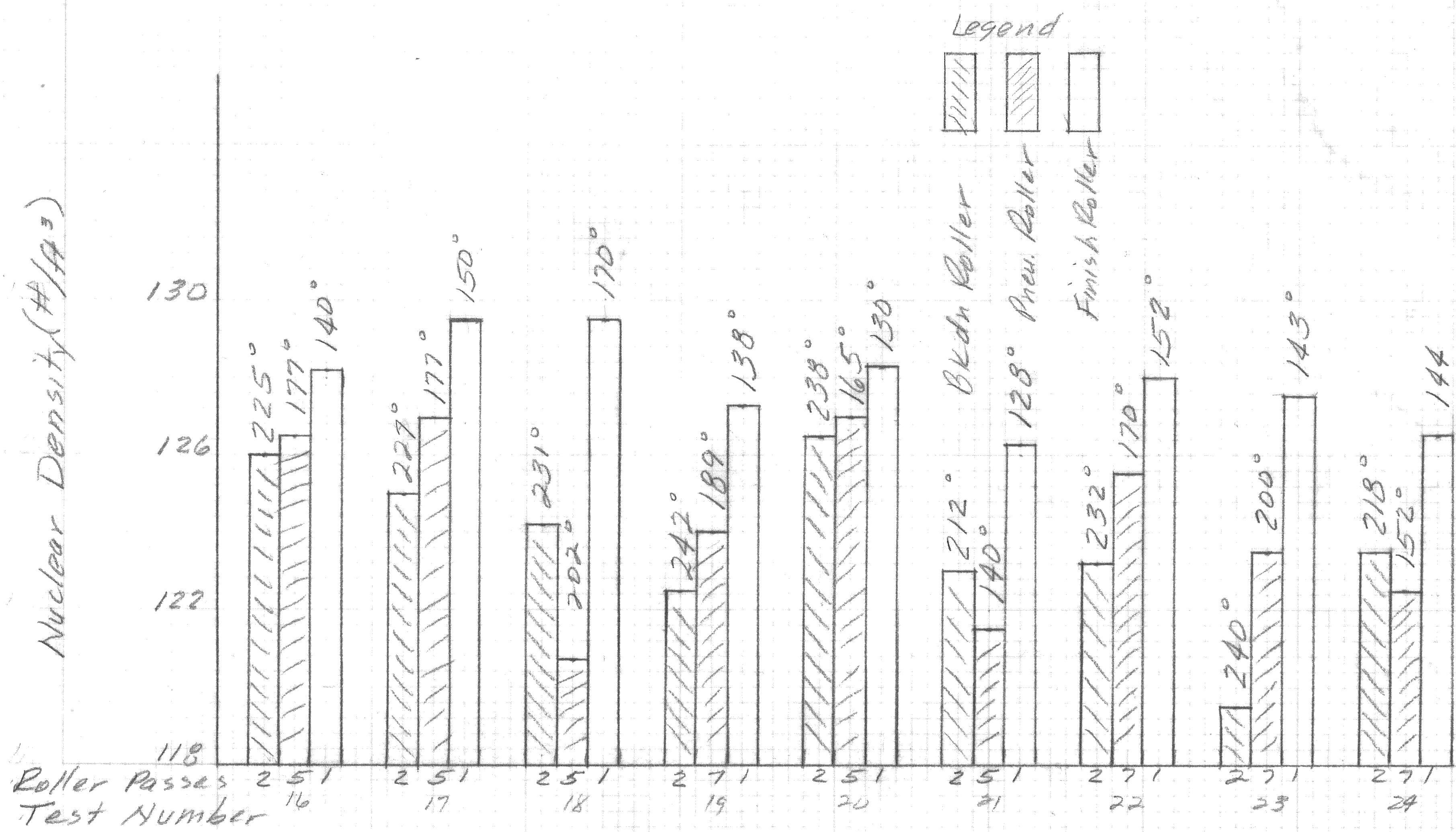
Note: Temperatures above Bars indicate final rolling temperature of Roller.

FIGURE 12- Roller Passes Versus Nuclear Density



Note: Temperatures above bars indicate final rolling temperature

Figure 13 - Roller Passes Versus Nuclear Density



Note: Temp. above bars indicates final rolling temp. of roller.

Figure 14 - Roller Passes Versus Nuclear Density